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THE APPLICATION OF AUTOMATIC DATA
PROCESSING TO THE SCHEDULING OF
REAL PROPERTY MAINTENANCE

DARRELL U. DAVIDSON

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Darrell U. Davidson

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by

Darrell U. Davidson

Major, United States Marine Corps

Submitted in partial fulfillment of
the requirements for the degree of

MASTER OF SCIENCE
IN
MANAGEMENT

United States Naval Postgraduate School
Monterey, California

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THE UNIVERSITY OF CHICAGO
DIVISION OF THE PHYSICAL SCIENCES
DEPARTMENT OF CHEMISTRY

RESEARCH REPORT
DEPARTMENT OF CHEMISTRY

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RESEARCH REPORT
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THE APPLICATION OF AUTOMATIC DATA
PROCESSING TO THE SCHEDULING OF REAL
PROPERTY MAINTENANCE

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Darrell U. Davidson

This work is accepted as fulfilling
the research paper requirements for the degree of
MASTER OF SCIENCE

IN

MANAGEMENT

from the

United States Naval Postgraduate School

ABSTRACT

Work scheduling is one of the cornerstones of a well managed real property maintenance program. This study addresses itself to the master work scheduling aspect of the Marine Corps Maintenance Management Program. This function has recently become more complex with the imposition of additional constraints. A computer based system consisting of a punched ~~card~~ job data library, computer programs and associated routines is proposed. The system is considered sufficiently developed for a pilot test project. Though the computer programs are based upon the IBM 1401 data processing system, the treatment of maintenance scheduling variables has application to any computer oriented approach to the problem.

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CHAPTER I

BACKGROUND

In November 1959, after an eleven-month test of a pilot project, the Marine Corps implemented its Maintenance Management Program¹ at all Marine Corps managed installations. Its objectives and procedures were essentially the same as those of the Controlled Maintenance Program developed by the Bureau of Yards and Docks and installed earlier or during the same period at Naval activities. That is, the goal was the application of sound management planning and control techniques to the efforts of real property maintenance organizations. In addition, it provided the uniform approach to real property maintenance which was required for Headquarters, U. S. Marine Corps, to be responsive to Congressional and Department of Defense requirements. Though involving a substantial overhead investment, the program offered the greatest promise of continued maintenance support in the face of level funding with rising costs and increasing plant investment.

¹This program was originally published for guidance in the Facilities Maintenance Manual, NAVMC P-1092-ED, of November, 1959. This manual was subsequently revised slightly and included in the directives system as Marine Corps Order P11000.4A under the same title. Though the program has no specific title, it will be referenced herein as the Maintenance Management Program.

The essence of the program is the handling of maintenance work in much the same manner as custom production work in industry. In this sense the program has capitalized upon the industrial engineering experience of the Services and private manufacturers. However, the extension of these techniques to maintenance and repair work has been pioneered by the military departments.

I. PRESENT SYSTEM

Operations Division. The essential feature of the Maintenance Management Program is the functioning of the Operations Division of the station Maintenance Department. This unit performs the necessary staff services of work detection, planning, scheduling, and control. Specifically, the following functions, considered essential elements of a successful maintenance program, are included:²

1. Inspection
2. Work classification
3. Work input control
4. Job authorization
5. Material coordination
6. Planning and estimating
7. Shop scheduling
8. Reports

²U. S. Bureau of Yards and Docks, Navy Civil Engineer, III (February 1962), p. 32.

Figure 1 is an organizational chart of a typical maintenance department and shows the relationships between the Operations Division and the maintenance shops, or work centers,³ which perform the work under the Maintenance and Repair Division. Figure 2 illustrates the organization of a typical operations division. Neither of these are to be considered as prescribed standards. Rather, they are representative and serve for illustrative purposes. A brief description of the activities of each unit of the Operations Division is in order to provide a background for subsequent discussion.

Inspection Unit. Ideally, the Inspection Unit is the point of origin for the preponderance of work accomplished by the Maintenance Department. The concept of detection of work requirements prior to breakdown is a basic premise of the Maintenance Management Program. All facilities are inspected on a regularly scheduled basis and corrective needs prescribed. In addition, this branch validates work requirements generated by other organizations.

Work Reception Unit. The Work Reception Unit is the initial receiving point for all work requirements. This may be in the form of work generated by the Inspection

³Throughout this paper the terms "shop" and "work center" are used interchangeably.

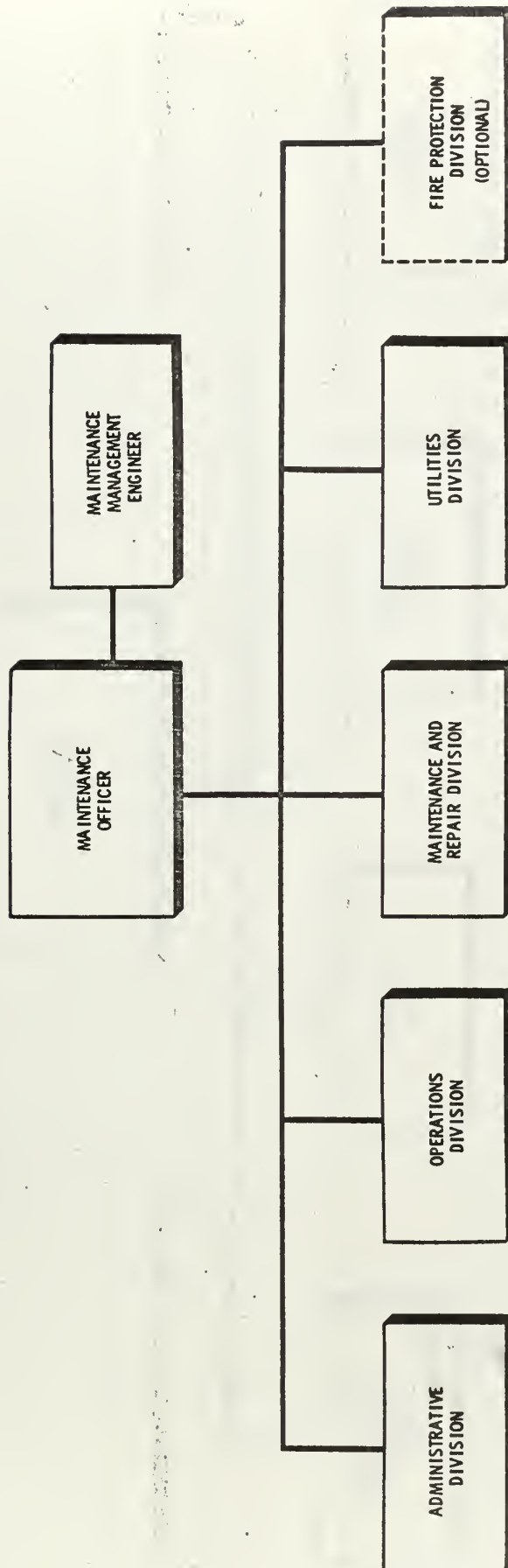


FIGURE 1
MAINTENANCE DEPARTMENT

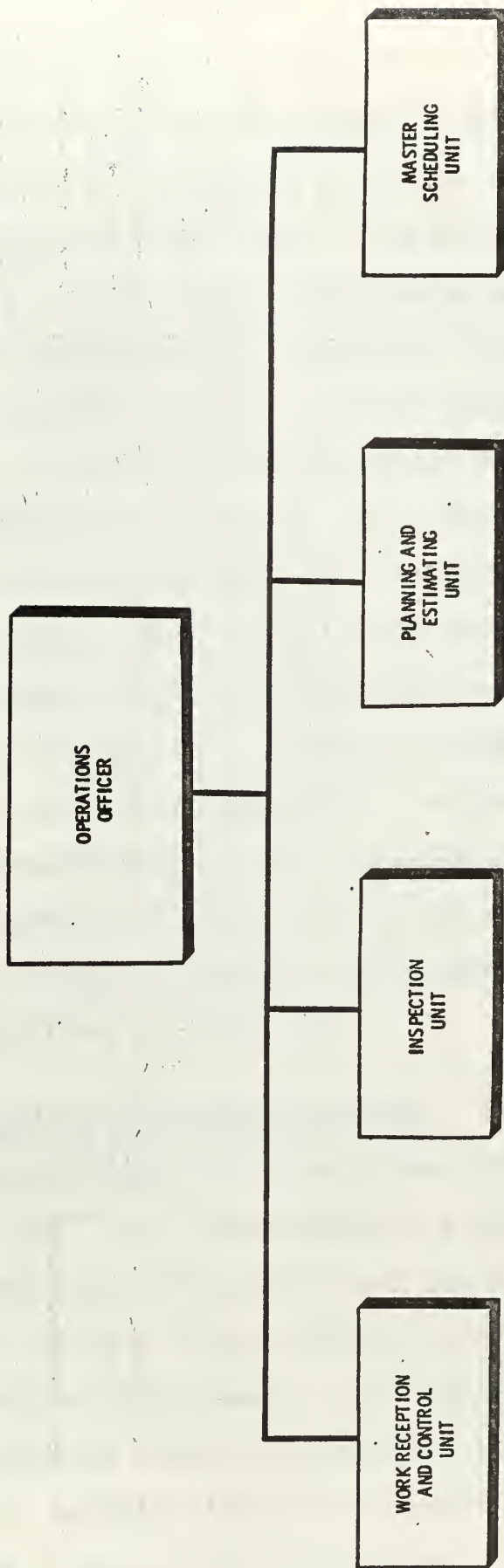


FIGURE 2
OPERATIONS DIVISION

Unit, written requests from organizations served, telephone requests for emergency work, and requirements originating within the Department. The Work Reception Unit must record receipt of the requirement and enter it into the control system so that tracer and follow-up action can be accomplished and a record of progress maintained. A variety of systems for establishing this paperwork control are feasible and in use. All involve the assignment of an identifying control number to each request.

An initial evaluation of all work is made by this Unit. Emergency work and minor service jobs requiring less than 16 manhours to complete can be authorized by this Unit. As indicated earlier, routine maintenance requests originating outside the Department are referred to the Inspection Unit for validation of work requirements. Most of the work requirements are forwarded to the Planning and Estimating (P&E) Unit.

Planning and Estimating Unit. The P&E Unit analyzes the work requirements and groups work into work packages--specific jobs. The composition of a job is a function of several variables among which are the nature of the work, the amount of work, the duration of the job, and funding and accounting requirements. Job estimates are developed using engineered labor performance standards whenever available. Material lists and specifications are prepared and become a part of the job estimate.

Scheduling Unit. Completed specific job estimates are forwarded to the Scheduling Unit where they are placed in the queue to await accomplishment. At the appropriate time, job estimates are selected for authorization as job orders. Jobs are then scheduled for completion by the work centers subject to the availability of materials, manpower, and funds. These activities are under the control of a master scheduler. Inasmuch as this study is focused upon the scheduling function, it will be described in much more detail below.

Operations Officer. The Operations Officer coordinates the efforts of the Operations Division. Within limits, he has work authorization authority. The extent of this authority, the degree of his participation in the chain of approvals associated with each job, and his voice in departmental policy is largely a function of the individual incumbent of this position.

II. THE SCHEDULING PROCESS

From the inception of the Maintenance Management Program, the scheduling function has been beset with difficulties in execution. Since the work schedule is the focal point of the desired performance control and evaluation, weakness here has serious implications for the entire program. To understand the nature of the problem, a

more detailed discussion of the scheduling sequence is necessary.

Managing the backlog. Beginning with the receipt of the completed job estimate from the P&E Unit, there is a requirement to keep track of this paperwork until it is prepared into a job order. Managing this backlog requires much more than just a filing operation. Some ready reference to each job, its urgency, and its labor and material requirements must be maintained. At the proper time, jobs must be selected from this backlog and prepared for issuance as job orders. The timing of this selection, or activation, is a key decision point. It is important that it be early enough to insure material is available when it is desired to start work. Further, it is necessary that the pool of activated work be sufficient to provide a backlog of work for all shops. However, this backlog must also be kept as small as possible since sound management must view an approved job order as a financial commitment. Allowing the pool of activated work to grow larger than is absolutely necessary substantially reduces the financial flexibility of the Department.

Job selection. Once activated, the job must be given even more attention than when a part of the backlog. Steps must be taken to schedule the commencement of work as soon as appropriate. Selection from the pool

of activated work those jobs to be worked has been the focal point of much of the criticism of the Maintenance Management Program. Current doctrine recognizes only two priorities of work, routine and urgent.⁴ This doctrine emphasizes a first in, first out (FIFO) sequence. Many maintenance managers have found strict FIFO an unacceptable approach. This has, in turn, led to accusations of capriciousness in work selection. The question of essentiality is also related to job selection. A recent management study of Department of Defense real property maintenance activities was critical of the lack of uniform standards of essentiality in work selection.⁵

Work planning. Once the jobs have been selected, the actual act of scheduling a shop for work is straightforward and uncomplicated provided adequate information has been provided in the job order (job estimate). Some jobs may have to be worked sequentially by the work centers while others can be worked simultaneously. Such details, as well as total labor requirements and rate of work must be included by the P&E Unit in the job estimate.

⁴U. S. Marine Corps, Facilities Maintenance Manual, MCO P11000.4A, (Washington: 1963), p. 5-15.

⁵Albert Ramond & Associates, Evaluation of Real Property Maintenance Activities (RPMA) for Department of Defense. Citation is from a synopsis of this report furnished to attendees at the Defense Real Property Maintenance Management Conference held at Warrenton, Virginia, in September, 1964.

The mere fact that a shop is scheduled for work does not insure that the work is actually accomplished. There are numerous reasons, justified and unjustified, for failure to meet a particular schedule. In fact, variation will be the usual case. Therefore, there must be a feedback of performance information to the master scheduler so that subsequent schedules can be adjusted accordingly. In addition, this feedback is required to provide management a basis for judgement of performance.

Weekly schedules. Work schedules are prepared on a weekly basis. The usual procedure is to have a tentative schedule for the following work week prepared by Thursday afternoon of each week. At that time it is discussed in a meeting with shop supervisors or planners, and necessary adjustments are made. The firm schedule is then prepared and published to each shop by Friday noon. This permits shop personnel some time for planning Monday work.

In preparing this schedule, the master scheduler must have data on the manpower availability in each shop. Not all the shop force is available for scheduled specific jobs. In addition to deduction for supervision, leave, overhead, and fixed assignments, a portion of the work force is left free of scheduled commitments to handle emergency and minor service work. The per cent of available productive labor which can be scheduled varies from

one shop to another, but a 75% average is probably a realistic goal.

A number of methods for communicating this weekly master schedule to the work center are available. Figure 3 depicts a standard form designed for this purpose. A separate form of this type is prepared by the master scheduler for each shop, or by the shops on the basis of a master document. Another system uses a larger chart and shows all work scheduled for all shops. It is duplicated by the Ozalid process and a copy furnished each work center.

Status keeping. Just as there are a variety of ways to communicate the schedule to the work centers, there are a number of techniques for keeping track of the status of jobs on the work schedule and those awaiting scheduling. Visual display boards, some with moveable components for updating, have been popular and helpful to some operations. They have the disadvantage of requiring a substantial investment of time in maintaining them in a current status. Further, in a large scale operation their size tends to obscure the information portrayed and the value is lost. Card files have also been used alone or in conjunction with status boards.

Summary. From the foregoing discussion it can be seen that there is heavy clerical content in the scheduling

WORK CENTER SCHEDULE (CONTROLLED MAINTENANCE)						WEEK ENDING: 8/10/63							
WORK CENTER: 41													
JOB ORDER OR SHOP CONTROL NO.	LABOR CLASS CODE	JOB DESCRIPTION	EST. ONLY - EST. DURATION (HRS.)	CARRY-OVER (HRS.)	SCH. ACT.	MAN-HOURS SCHEDULED							REMARKS
					DAILY								
					M	TU	W	TH	F	SS	WEEKLY TOTAL		
1. TOTAL NO. OF PERSONNEL					S								
					A								
					S								
					A								
OVERHEAD (Including Delay Time)					B								
					A								
					S								
					A								
4. FIXED ASSIGNMENTS					S								
					A								
5. AVAILABLE FOR SCHEDULING					S								
					A								
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FIGURE 3

WORK CENTER SCHEDULE

Source: MCO P11000.4A

function. Of more significance, it is apparent that the work schedule is completely dependent upon the accuracy of the plans and estimates developed by the P&E Unit. These, in turn, are dependent upon the completeness and currency of inspection reports and, more importantly, upon the labor standards used in developing the job plan. Inaccurate estimates preclude realistic scheduling as well as the necessary growth of management confidence in, and work center respect for, the schedule. The application of engineered labor performance standards which have now been installed at all major activities is a key step in improving the dependability of job estimates. As experience with these standards broadens, it can be anticipated that estimating inaccuracies will no longer be significant scheduling problems.

III. FUNDING CONSTRAINTS

The discussion of scheduling to this point has given little attention to funding considerations. It is only in recent years that fund constraints have become a major concern to the master scheduler. This constraint has become so critical that it is now of paramount importance in any scheduling decision. In the first years of the program virtually all productive work was financed from one fund source. However, increased Congressional and OSD interest in real property maintenance costs, and the separate

identification of family housing have been the genesis of a proliferation of fund sources. That is, separate identification of funds through separate appropriations or budget projects within the Operation and Maintenance, Marine Corps, appropriation. Since the labor force is dependent for its financial support upon these numerous sources, the commitment of resources (to work) from each source in accordance with a definite plan has become a new and vital scheduling consideration.

The fact that this financial constraint has multiplied the number of scheduling steps by the number of fund sources has required additional personnel and data support for the scheduling function. The alternative to providing this support is regression to chaotic scheduling. As mentioned above, performance feedback data is a necessary element for future scheduling. However, where previously interest could be confined to weekly progress on specific jobs, multiple funding also makes it necessary to know weekly labor charges in each fund area.

IV. THE TURN TO AUTOMATIC DATA PROCESSING

It is against this background that the present study was undertaken. The objective was to demonstrate the potential of automatic data processing (ADP) techniques for handling the increasingly detailed scheduling problem and to develop an initial useable computer based system. The

turn to ADP for a solution is a natural step for a number of reasons.

1. The recent success of industrial applications of the computer to production control.

2. The high clerical content of the scheduling function. It is such routine work which is best suited to automation.

3. The fact that scheduling decisions appear reducible to a series of comparatively easily identified dependent decisions.

4. The availability of ADP equipment at all major installations.

5. The unacceptability of meeting the increased detail of scheduling by expanding the number of personnel devoted to it.

Present ADP services. ADP is not a stranger to real property maintenance managers. Allotment and cost accounting systems have for some time been keyed first to EAM and more recently to the computer. Several regularly consulted management reports have been prepared by ADP. However, the support received has been largely limited to by-products of this accounting system. This study envisions the application of ADP in a more operational role than that associated with the present after-the-fact accounting reports.

Existing systems. No evidence was found of an operating ADP-based scheduling system for real property maintenance within the Department of the Navy. The author was aware of at least one Air Force installation in Texas that used a punched card system for authorization and control of some types of work.⁶ A Navy sponsored effort by the Stanford Research Institute approached the problem but focused upon shop level rather than master scheduling. Though this study was Navy-based, the similarity between maintenance management programs is so complete that the study is equally applicable to the Marine Corps. The following excerpt explains the SRI position:

The number of constraints involved in the above (master scheduling), together with other complicating factors makes it unwise, in our opinion, to contemplate thorough study or attempted overhaul of scheduling in the present contract. We observed it, discussed it with managers involved, and feel qualified even to make general statements about it. In another section of this report we discuss the possibility of automating this undertaking. Here, we take the position that this process is well-performed by experienced personnel, and that it would be an undertaking the scope of which is outside that of the present contract to overhaul the methods used by the master schedulers to match and equilibrate their shoploads.⁷

⁶Statement made by Major General R.H. Curtin, Director of Civil Engineering, U. S. Air Force, in a conversation with the author, 1963.

⁷Stanford Research Institute, Scheduling Maintenance Activities of Public Works Centers with the Aid of Automatic Data Processing Equipment (Menlo Park, Calif.: Stanford Research Institute, 1965. Bureau of Yards and Docks contract NBy-32268 for Naval Civil Engineering Laboratory, Port Hueneme, Calif.).

The author readily agrees that the master scheduling system is complex. It could even be allowed that it is well performed at some locations. However, it is contended that there is a universal need for assistance in the face of multiplying requirements.

V. SUMMARY

The work scheduling function is one of the cornerstones of the Marine Corps Maintenance Management Program. Maintenance work scheduling has always involved complex considerations, but the problem has been compounded by recent fractionations of applied funds. Automatic data processing appears to offer a promising means of coping with the increased complexity. No evidence has been found of previous work on this specific problem.

CHAPTER II

PROJECT OBJECTIVES AND CONSTRAINTS

The objective of this study, already stated in part in Chapter I, was as follows:

To develop a computer based system of procedures to accomplish the scheduling of real property maintenance work within the Marine Corps Maintenance Management Program.

I. ORGANIZATION OF THE STUDY

Conduct of the study consisted of a number of subordinate tasks which were undertaken in the order listed below.

1. Establishment of constraints, procedures, and guidelines.
2. Specification of desired outputs.
3. Identification of variables.
4. Selection of an algorithm.
5. Specification of inputs.
6. Computer programming.
7. Preparation of a simulated job library.
8. Test of the system.
9. Identification of potential refinements.

Each of these phases will be discussed in varying detail in this and succeeding chapters.

II. STUDY CONSTRAINTS

As a point of departure it was first necessary to prescribe some general constraints, guidelines, and assumptions for the conduct of the project. Inasmuch as the objective of the project implicitly included the development of a computer program or programs which would be useable with limited modifications, certain of these constraints naturally followed.

Data processing system. It was determined that the project should be based upon the International Business Machines (IBM) 1401 data processing system. Although a Control Data Corporation 1604 system was also available, the choice of the 1401 was natural since this is the equipment in use at all major Marine Corps installations. Specifically, the 1401 system utilized contained the following equipment.

- 1 - 1401 Processing Unit
- 1 - 1406, Model 3 (16,000 character), Storage Unit
- 1 - 1402 Card Read-Punch
- 1 - 1403 Printer
- 2 - 729 Magnetic Tape Unit

Although the system was also equipped with the 1311 Disk Storage, this feature was not used since it is not widely available at Marine Corps installations.

Programming language. All programming was done using the Symbolic Programming System (SPS) for the IBM 1401. This presented a formidable learning task for the author since he had no previous exposure to this language. Though FORTRAN II, with which the author had some familiarity, was available, it was rejected. The reasons were its mathematical orientation which was not of significance in the programs contemplated, the uneconomical (of program steps) method of handling conditional branches, the loss of much of the variable word length advantage of the 1401, and the nonavailability of subroutines. Further, the extent of its availability throughout the Marine Corps was unknown.

Scenario. It was decided that the programming and subsequent test of the system should be based upon a hypothetical maintenance department with simulated jobs rather than upon a department at a specific installation. It was hoped that this would avoid the pitfall of becoming excessively involved in programming for local details which would contribute little to the general solution. A department with eight scheduleable work centers and eight fund sources was selected as the hypothetical model. This is more than adequate to include most existing departments.

Keypunch availability. The availability of keypunch equipment within the maintenance department was assumed. Acquisition of keypunch, if not already on hand, is considered essential to support the system developed herein.

Savings desired. Any system for accomplishing work scheduling should not impose additional burden upon the work centers for input information. Further, a personnel reduction in the Operations Division is desirable. An increase could be justified only by the clear demonstration of the immediate overall savings to be realized.

III. OUTLINE OF THE SYSTEM

Following delineation of constraints, it was necessary to sketch in general terms the structure of the system. Emphasis was placed upon developing a system of routines which would involve a minimum of modifications of existing Operations Division organization and procedures. A system capable of manual operation in an emergency was sought. This consideration plus the restriction to use of present ADP equipment, discussed above, limited the choice of outputs and inputs to printed reports and punched cards. A system with the following provisions was envisioned:

1. Cognizance over all specific jobs which are planned and estimated. This included estimates pending

approvals from outside the Department. It excluded all work in the emergency, minor service, and fixed assignment categories which are not included in present scheduling.

2. A punched card library of information on all jobs under the cognizance of the scheduling system.

3. A printed work schedule output which would indicate to each work center the labor to be applied to each scheduled job during a one week period.

4. A periodically revised printed listing of all jobs under the cognizance of the system with details of the job and its current status.

5. Periodic printed reports of all work in the backlog to serve the master scheduler and management.

6. An information feedback provision to continuously inject actual performance data into the system.

7. Emphasis upon automatic updating of the punched card library.

IV. SYSTEM NAME

To emphasize that the project contemplated the development of a complete system and not just a computer program, the attachment of a name to the system was considered appropriate. In addition, the name would assist in eliminating any confusion in whether the total system or only one of the computer programs was being referenced.

The name "Autosked", formed by attaching the "auto" prefix to the phonetic abbreviation for the word "schedule", was considered descriptive and appropriate.

CHAPTER III

OPERATION OF THE SYSTEM

This chapter is an overview of the operating features of the Autosked system as developed by this study. Later chapters are devoted to an examination of the most significant details of the system.

I. SYSTEM MANAGEMENT

Autosked is managed by the master scheduler in the Operations Division. His primary concern revolves about a punched card Library Deck of information on all jobs under the cognizance of the Autosked system. He must insure that this data bank reflects the latest information on each job. In addition, he monitors work requirements as they are received or completed and makes manual adjustments as necessary during the work week to allow for circumstances not provided for within the system. At the appropriate times he delivers the Library Deck and other input data to the computer center for processing. He receives and distributes the outputs generated by the computer processing.

Scheduling cycle. Autosked, like the present manual system, involves a weekly cycle. The highlights of the Autosked cycle are:

1. Preparation of the Shop Work Schedule for the forthcoming week after the performance results for the current week are known.

2. Preparation of a Job Listing and two Work Backlog Reports on Monday or as soon as the Shop Work Schedule has been prepared and its impact reflected in revisions posted to the Library Deck.

3. Preparation of a Tentative Shop Work Schedule for the forthcoming week on Thursday morning for use at the Thursday afternoon scheduling meeting. This cycle is depicted in Figure 4. The following description of Autosked operation will adhere to the sequence shown in the figure.

Library Deck. As job estimates are received in the Scheduling Unit from the P&E Unit, data is extracted and punched into a set of ten data cards. These are identified as a Master Card, a Job Description Card, and eight Shop Cards, one for each work center. A card is required for a work center even though it does not have work on a particular job. Figure 5 is a ten-card set for one job. The set must be maintained in the sequence shown; that is, Master Card, Job Description Card, and Shop Cards for Work Centers #1 through #8.

This set is hand-inserted into the Library Deck which is a collection of such sets for all jobs included

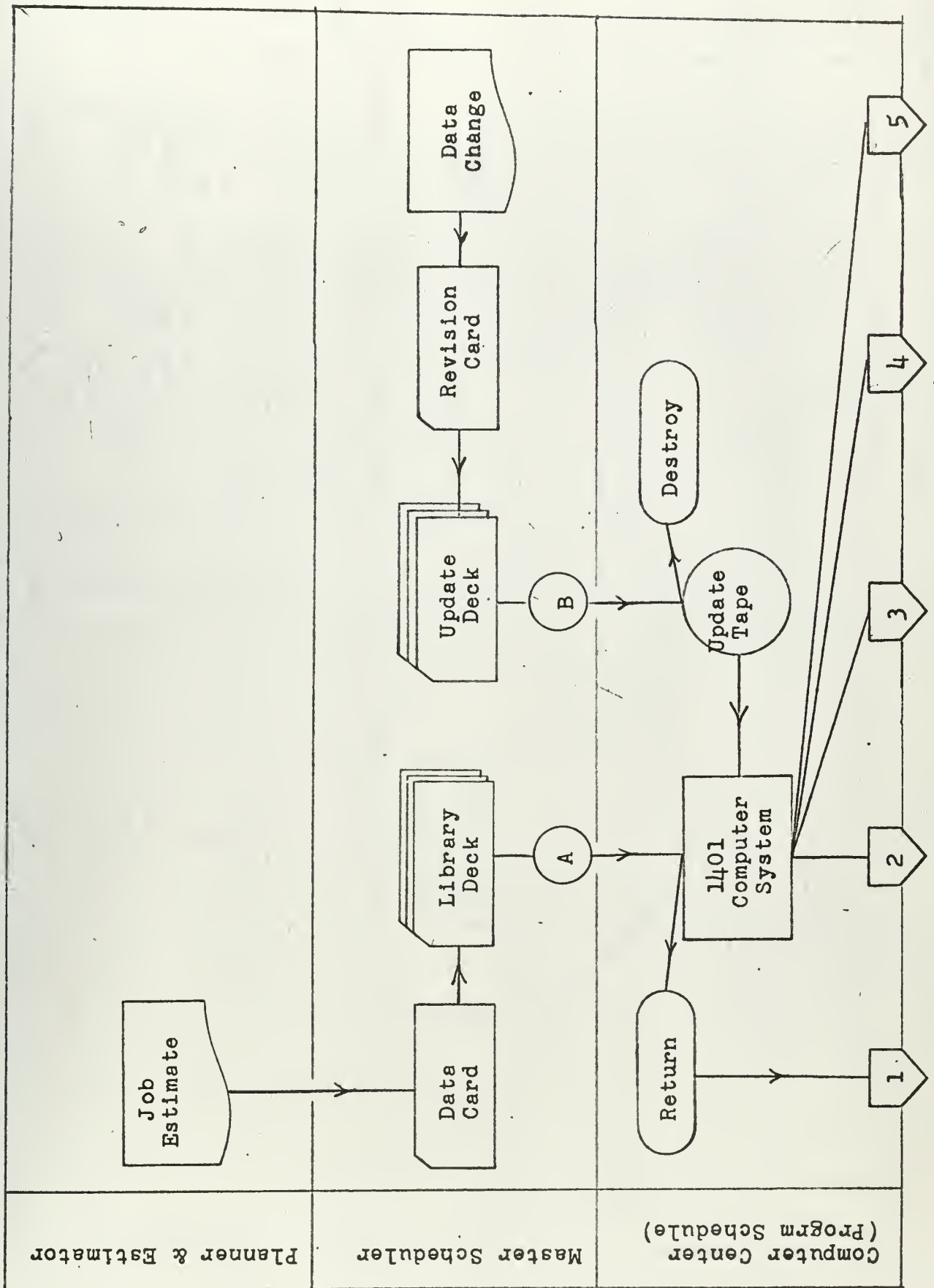


FIGURE 4e. AUTOSKED SYSTEM CYCLE

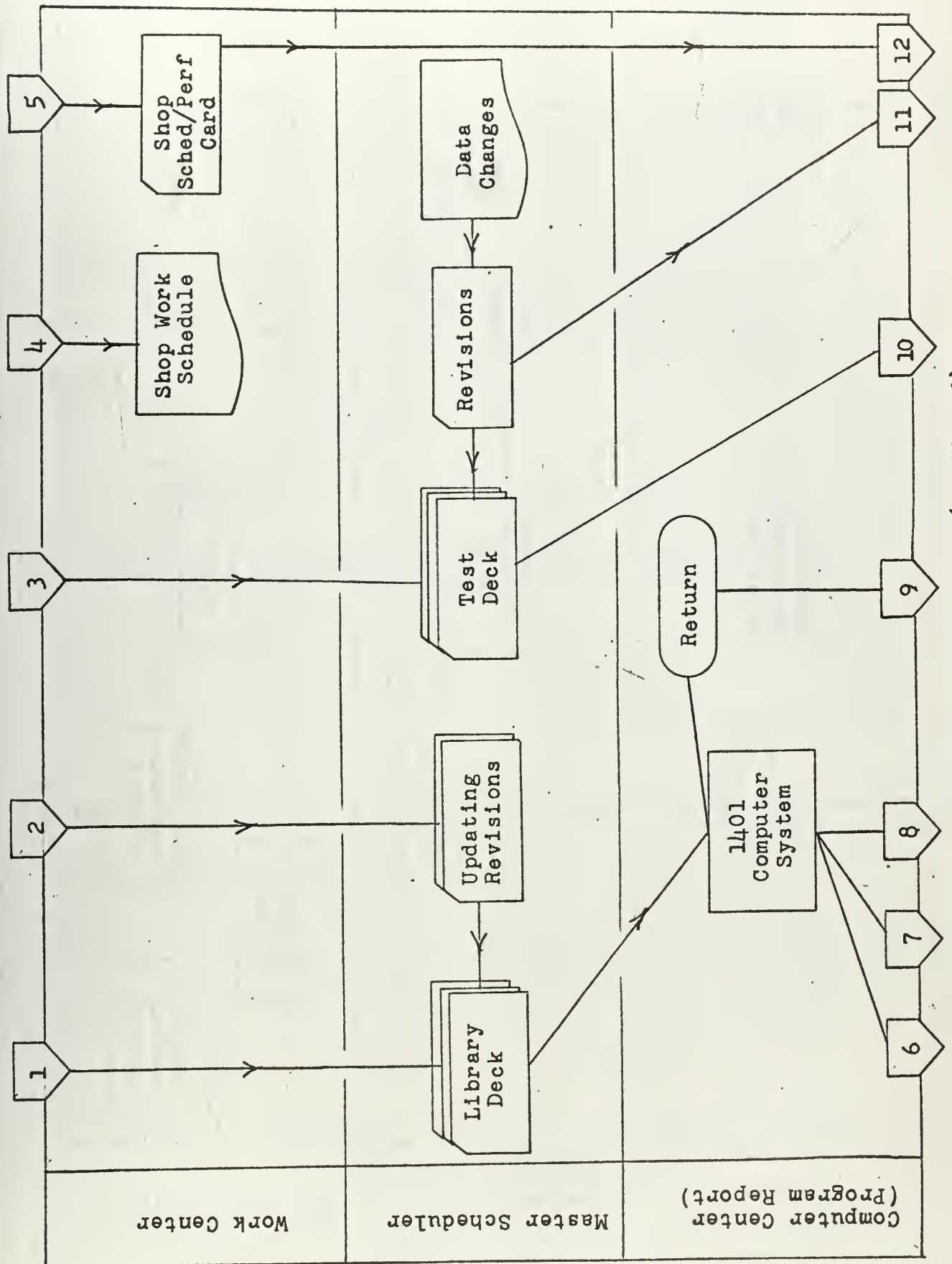


FIGURE 4b. AUTOSKED SYSTEM CYCLE (Continued)

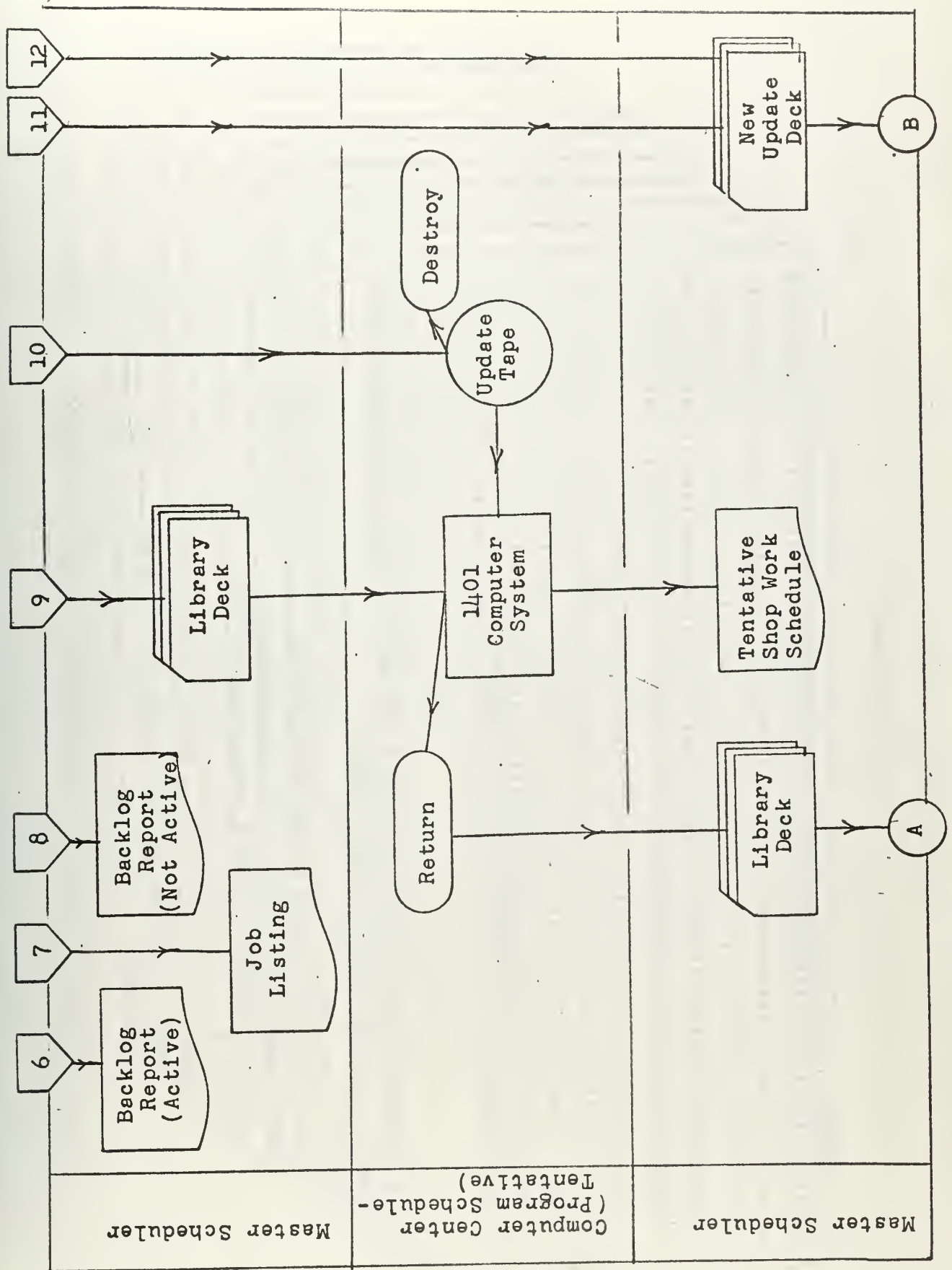


FIGURE 4c. AUTOSKED SYSTEM CYCLE (Continued)

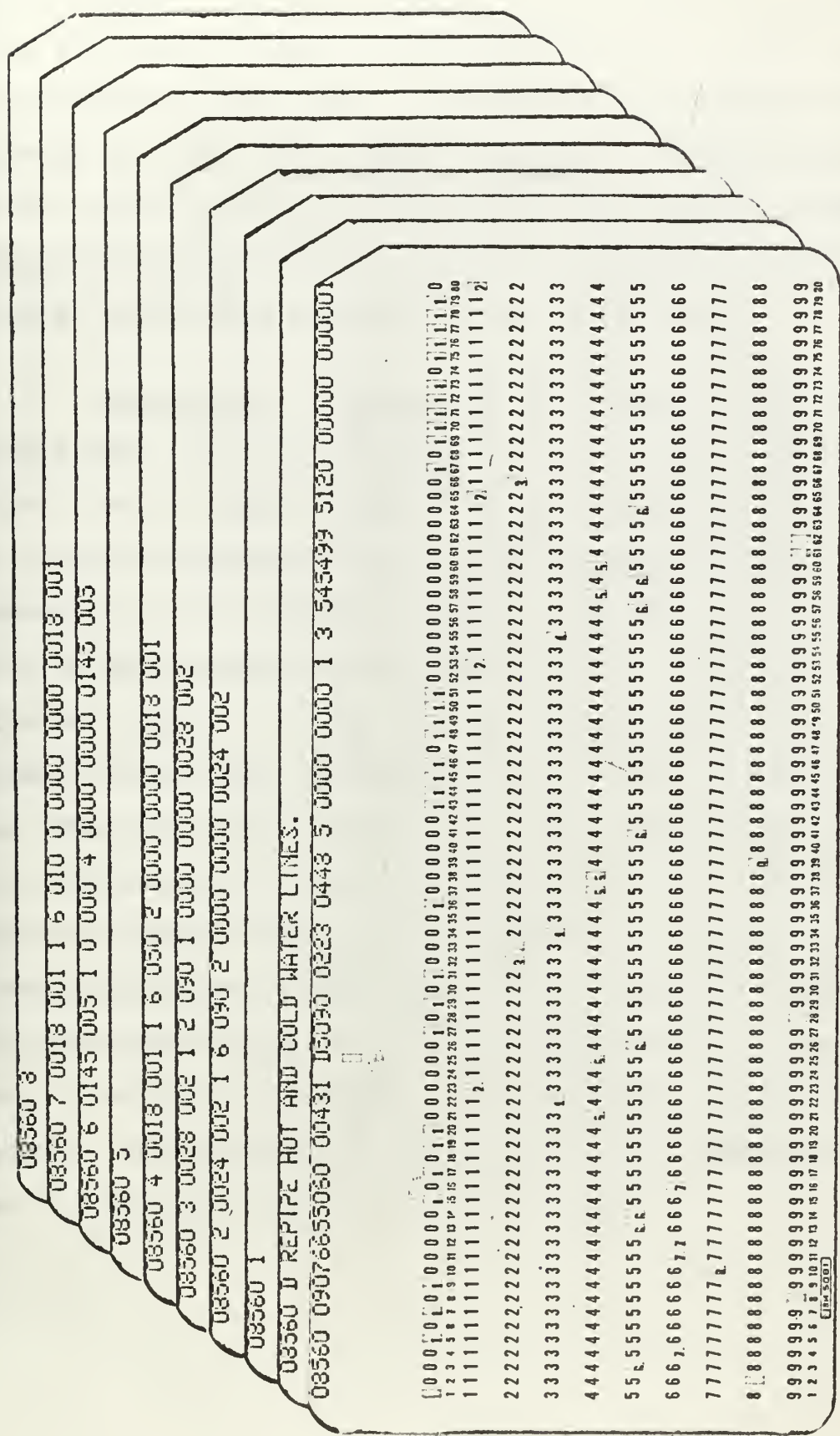


FIGURE 5

TEN-CARD SET FOR ONE JOB IN LIBRARY DECK

in the system. Jobs are identified throughout the system by a five-digit control number punched into the first five columns of each data card. Job sets must be placed in the Library Deck in control number sequence. Failure to do so will cause erroneous outputs from the computer programs. Chapter IV is devoted to a detailed description and discussion of the data contents of the Library Deck.

Update Deck. Supplementing the Library Deck is the Update Deck. Its sole purpose is to serve as a temporary repository for data to modify or amend the Library Deck. This data is injected into the Library Deck during the execution of the computer programs. The bulk of the Update Deck is Shop Schedule/Performance Cards which will be discussed later. In addition, the Update Deck is the primary vehicle for posting changes in status, priority, and other job data to the Library Deck. A typical occasion for revision would be upon activation of a job. The new data is punched into the proper field in an appropriately identified Master or Shop Card and the card hand inserted into the Update Deck. As an alternative, the Library Deck can, of course, be modified by a direct card replacement. However, this procedure requires more manual operations and is, therefore, more subject to error.

II. SCHEDULE PREPARATION

The work schedule for the forthcoming week is prepared at the computer center at the end of each work week, Friday unless a holiday is involved. This requires work after normal working hours on Friday for a portion of the Scheduling Unit and assumes two-shift operation of the computer center. If this is unacceptable, the work schedule can be prepared Monday morning with a sacrifice of some planning time by the shops.

Input data preparation. The Library and Update Decks and a set of five parameter cards are delivered to the computer center for processing. The Update Deck is processed first to transfer the contents to magnetic tape. The card-to-tape program required should be available in the computer center library and has not been included in the programs for Autosked. Once transferred to tape, the Update Deck can be destroyed. However, retention on file for a period of time is recommended to maintain a record and to facilitate tracking in case of errors.

The Library Deck is processed by executing Program Schedule. The Update Tape is mounted on Unit #1 and a scratch tape on Unit #2. The five parameter cards introduce additional information required by Program Schedule. This includes:

1. The date and number of days in the work week.

2. Season information.
3. Constants used in rank ordering jobs.
4. Manhour availability in each work center.
5. Minimum and maximum limits for each fund source.

Shop Work Schedule. Program Schedule generates both printed and punched card outputs. The printed output is the Shop Work Schedule for the forthcoming week. Figure 6 is a sample last page from a Shop Work Schedule. Jobs appear in control number sequence. The fund source from which the job is financed is identified. The payoff is used to rank order the jobs. Its calculation is discussed in Chapters V and VI. The number of manhours scheduled for each of the eight shops on each job is given. Two dashes (--) in the manhour position signify that the shop has no work on that job. A blank indicates that the shop has work on the job but none is scheduled. The notation "FIN" means that the shop has finished its portion of the job. Each work center gets a copy of the entire schedule. This has the advantage of informing each shop of the total picture for each job, a shortcoming of the type form shown in Figure 3, Chapter I.

The last page only of the Shop Work Schedule will carry the manhour totals scheduled for each work center. This should total the availability prescribed by the parameter card. If this level is not scheduled, a notation of this fact is added at the bottom of the page. Manhour

SHOP WORK SCHEDULE FOR THE WEEK ENDING 21 MAY 1965

UNITS = MANHOURS

JCB	FUND	PAYOFF	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8
8330	2	339	--	--	164	--	--	--	--	--
8772	7	503	32	--	--	--	--	--	--	--
8999	3	677	20	1	--	20	--	20	6	--
9489	2	341	--	--	--	--	--	--	16	--
9703	1	418	--	--	--	--	--	--	16	--
9945	4	502	8	--	--	--	--	--	--	40
10089	5	429	--	--	--	--	--	--	--	160
10547	8	335	29	--	--	--	--	--	--	--
10754	6	500	--	--	--	--	--	120	--	--
10767	2	668	24	--	--	--	--	--	--	--
10821	5	463	32	--	--	--	--	--	--	--
10823	2	453	131	8	--	34	18	10	--	--
11667	1	368	--	--	--	--	--	--	80	--
MANHOUR TOTALS =			390	77*	360*	300	140	170	280	810

FUND SOURCES 1 2 3 4 5 6 7 8
 MANHOUR TOTALS = 202 816 67 128* 622 120 500 72

* = INSUFFICIENT ACTIVATED WORK TO MEET SPECIFIED REQUIREMENTS

FIGURE 6

SHOP WORK SCHEDULE

totals scheduled for each of the eight fund sources are also given on the last page. These totals should fall between the prescribed minimums and maximums. If a minimum is not met, an asterisk and the appropriate note are added.

Shop Schedule Performance Cards. Three different punched card outputs are generated by Program Schedule. The punch hopper should be loaded with blank cards printed with the Shop Schedule/Performance Card format. This, of course, means that all cards punched will be on this form which is applicable to only one of the three different outputs. This will not impair the use of the other two outputs, however.

The Shop Schedule/Performance Card, Figure 7, goes to the work center with the Shop Work Schedule. It contains all the data of a Shop Card plus the number of manhours scheduled for the week and the date of the last working day of the week. When the card is received in the shop, the Hours Worked field is blank. At the end of the week the shop supervisor writes in the number of manhours actually worked and returns the card to the master scheduler. The Hours Worked field is punched into the card. As indicated earlier, these combined Shop Schedule/Performance Cards make up the bulk of the Update Deck.

In recognition of the fact that estimates of job manhours and workday duration are subject to some

Hours Scheduled

Hours Worked

Date Week Ends

Same data as Shop Card.
See Figure 11, Chapter IV.

03522 8 0200 005 1 0 000 1 0000 0020 0120 003 0070 0072 11 JUNE 1955

SHOP SCHEDULE/PERFORMANCE CARD

0000 1111 2222 3333 4444 5555 6666 7777 8888 9999

0 0 7 2

A B C

1. "A" is est. manhours remaining at start of week.
2. "B" is est. workdays remaining at start of week.
3. "C" is manhours to be worked this week.
4. At end of week write manhours actually worked in Box "D" and turn in card.
5. Make entries in Boxes "E" & "F" only to revise Job Estimate. See Scheduling Instructions for details.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

FIGURE 7
SHOP SCHEDULE/PERFORMANCE CARD

inaccuracy, the shop supervisor may communicate to the scheduler his estimate of actual work remaining by means of the Shop Schedule/Performance Card. This is done by completing blocks "E" and "F" on the card. This is warranted only when the shop supervisor recognizes that posting the Hours Worked, which is done by the computer, would result in an incorrect picture of the work remaining. For example, if the shop were scheduled for 64 hours and completed its portion of the job, but did not use all 64 hours, it would be necessary to report the revised estimate. Block "E" would show 000 manhours and block "F" 00 mandays. These entries serve as a signal to the key-punch operator to prepare a revision card to be included in the Update Deck following the Shop Schedule/Performance Card.

Other Punched Card Outputs. The second type of punched card output from Program Schedule is revisions to the Library Deck. These cards reflect data inserted via the Update Deck as well as changes resulting from the scheduling process. These cards are delivered to the Scheduling Unit for insertion in the Library Deck.

The third punched card output is a special Test Deck. Its format and purpose will be explained later in connection with preparation of the Tentative Shop Work Schedule.

JOB LISTING--CONTROL NO. AS CF 18 MAY 1965

ORIG. NO.	DATE	PRIOR.	FUNO	JON	RELATED	CATL	NOS.	STATUS
228	FACILITY=WCASG	JOB= CLEAN ALL CATCH BASINS AND DO DRAINAGE WORK.						
26	359-64	4170	5	7	00000	00229	00000	IN APPROVED BACKLOG AWAITING ACTIVATION
288	FACILITY=02014	JOB= INSTALL WIRE MESH ON 3 CELL BLOCKS						
49	17-65	4192	9	3	44006	00000	00000	ACTIVATED AWAITING SCHEDULLING
740	FACILITY=2910C	JOB= REPAINT LOWER FLCOR ROOMS.						
05	111-65	4200	4	5	00000	00000	00000	IN APPROVED BACKLOG AWAITING ACTIVATION
983	FACILITY=WCASG	JCB= REMOVE WEEDS FROM HELD LANDINGS AND RUNWAY CVERRUNS. STERILIZE AREA.						
26	358-64	4155	5	7	40510	00000	00000	ACTIVATED AWAITING SCHEDULLING
1007	FACILITY=ROADS	JCB= REPAIR ASPHALT ROADS.						
10	44-65	4204	5	2	00000	00000	00000	IN APPROVED BACKLOG AWAITING ACTIVATION
1301	FACILITY= 3252	JOB= MCVE PAINT SPRAY BOOTH						
12	116-11	5111	9	1				DEFERRED BY MAINTENANCE OFFICER
1338	FACILITY=ORLPR	JOB= CONSOLIDATED MINCR WORK TO REAL PRCPRTY.						
16	125-65	5104	4	2	45022	00000	00000	ACTIVATED AWAITING SCHEDULLING
1670	FACILITY=MISCL	JCB= REPLACE ELECTRIC PANELS IN 27 C-PLTS.						
12	9-65	4210	6	2	00000	00000	00000	IN APPROVED BACKLOG AWAITING ACTIVATION
1877	FACILITY=ROADS	JCB= REPAIRS TC ROADS AND SIDEWALKS.						
09	34-65	4257	5	2	00000	00000	00000	IN APPROVED BACKLOG AWAITING ACTIVATION
2443	FACILITY=02045	JCB= MISCELLANECUS REPAIRS ANC EXTERICR PAINT.						
11	97-64	4240	6	2	00000	00000	00000	IN APPROVED BACKLOG AWAITING ACTIVATION
2584	FACILITY= 2112	JOB= INSTALL VENTILATION SYSTEM						
16	834-70	5111	5	6				REIMBURSABLE WORK PENDING APPROVAL CF REQUESTOR
2892	FACILITY= HGRS	JCB= INSTALL GROUNDING SYSTEM						
12	497-38	5111	3	7	45891			ACTIVATED AWAITING SCHEDULLING

FIGURE 8

JOB LISTING

JCB LISTING-WORK BACKLOG (ACTIVATED, NOT COMPLETED) AS OF 18 MAY 1965

UNITS = MANCURS		* = HELD FOR MATERIAL							
JOB	FUND SOURCE	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8
4961	4	--	--	--	--	--	--	155*	--
5374	8	32	--	3	32	64	--	--	--
5887	2	--	--	--	--	32	--	--	--
6247	2	51	16	22	6	--	36	44	--
6705	3	24	--	6	--	--	--	--	16
6834	7	40	48	1195*	48	--	72	--	--
7073	2	200*	--	--	16	32	--	32	16
7751	3	71	--	18	53	4	--	--	16
8073	5	--	--	--	--	--	--	--	256
8177	2	12	--	--	--	--	4	2	--
8330	2	2	--	164	--	--	--	--	--
8494	2	95	--	68	--	--	--	--	--
8560	5	--	24	28	18	--	145*	18	--
8772	7	32	--	--	2*	--	--	56	--
8999	3	74	8	32	54	--	51	6	--
9489	2	44	--	162	--	--	--	33	--
9611	2	8	--	31	--	--	4	2	38
9703	1	--	--	--	54	--	64	16	--
9742	1	9	24	--	20	80	--	--	--
9945	4	8	40	--	--	--	32	--	40

FIGURE 9

BACKLOG REPORT (ACTIVATED, NOT COMPLETED)

JCB LISTING-WORK BACKLOG (NOT ACTIVATED) AS OF 18 MAY 1965

JOB	FUNC	SOURCE	UNITS = MANHOURS								* = MATERIAL ORDER REQUIRED							
			SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8								
8558	5	--	--	24	8	8	--	145*	8	--								
8575	5	--	--	24	8	8	--	145*	8	--								
8783	2	--	--	145	30	--	--	--	--	60								
8798	2	24	24	16	8	16	16	32	16	--								
8817	2	--	--	--	--	--	--	58	42	--								
8880	2	87	3	42	36	--	--	48	11	32								
9055	3	4	--	--	--	16	--	--	16*	--								
9315	6	--	--	24	270*	--	--	--	--	--								
9664	1	--	--	--	--	--	--	--	328	--								
9685	8	--	--	--	--	--	--	--	--	352								
9709	2	51	--	--	20	--	--	--	24	--								
9858	1	--	--	--	--	--	--	160	64	48								
9897	1	200	--	--	--	--	--	--	16	--								
10088	5	--	--	--	120	--	--	--	--	--								
10330	5	72	24	24	5	74	--	48	10	36								
10331	5	286	128	128	136	2	--	--	60	188								
10770	2	--	--	--	--	--	--	--	--	198								
10882	2	--	--	--	--	--	--	--	--	128								
MANHOUR TOTALS =			1877	693	1839	683	159	926	1637	4738								

FUND SOURCES	1	2	3	4	5	6	7	8
MANHOUR TOTALS =	816	4251	36	951	4172	1056	654	616

FIGURE 10. BACKLOG REPORT (NOT ACTIVATED)

activation.(Figure 10). Each contains notations of special material considerations. As with the Shop Work Schedule, the last page of each Work Backlog report carries the man-hour totals for each of the eight work centers and the eight fund sources. These reports serve as working documents to the master scheduler and as management reports. In the short run they are the basis for Inspection Unit and P&E Unit work emphasis. In the long run they indicate the need for financial and manpower adjustment.

IV. TENTATIVE SCHEDULE PREPARATION

A weekly Thursday afternoon meeting between the scheduler and shop supervisors or planners is a part of the present system and is retained in Autosked. It is necessary that a tentative plan for the next week be available at this meeting. Further, since the firm Shop Work Schedule will not reach the work centers until Monday, they must have some basis for planning Monday work. The Tentative Shop Work Schedule fulfills these needs.

The Tentative Schedule is based upon the assumption that all work scheduled, no more or less, will be completed. It is prepared by executing Program Schedule with certain minor adjustments. The Library Deck and the five parameter cards are processed in the same way as in preparing a normal schedule. However, the punch routines are by-passed since the punch outputs are not normally needed in connection

with a Tentative Schedule. Console switch settings insert the word "Tentative" in the report heading and by-pass the punch routines.

Test Deck. The Test Deck generated during the previous execution of Program Schedule is used in place of the Update Deck. The Test Deck cards contain only control numbers, shop identification, the manhours scheduled and the date. The unique feature is the fact that the Work Scheduled field has been punched into the Work Completed field. Thus, Program Schedule treats it as accomplished. Since revisions which have arisen from data changes are pertinent to the Tentative Schedule, cards bearing this data must be merged into the Test Deck as is done with the Update Deck. As in the case of the Update Deck, the Test Deck can be discarded once it is transferred to magnetic tape. However, the best practice would be to retain it for a period for record purposes.

Projected schedules. Properly, master scheduling is concerned not only with the forthcoming week but with projection into the next several weeks. The Tentative Schedule procedures provide a means for accomplishing this forward planning. A series of Tentative Schedules can be prepared by repeating the computer program a number of times. In this case the punch outputs should not be by-passed and each repetition will generate a new Test

Deck. Of course, a new set of parameter cards would be required for each repetition.

V. SYSTEM DIMENSIONS

Computer core storage limitations. As presently programmed, computer core storage limits the capacity of the Autosked system. Methods for relief of this limitation are discussed in Chapter VI. From the standpoint of the Library Deck, there is no limit to the number of jobs which can be accomodated. This is also true of the Job Listing phases of Program Report. However, the Work Backlog Reports are dependent upon a core storage table of job information on those in the "activated" and "approved, but not activated" categories. A maximum of 240 such jobs can be accomodated within the core memory of a 16,000 character capacity unit. This serves to limit the size of the system to 240 jobs in these categories plus any number of jobs in other categories as described in Chapter IV.

In addition, Program Schedule uses a core memory table with a capacity of 125 jobs. However, these jobs are only those in the "activated" category. This serves as a subordinate limitation within the 240 jobs mentioned above.

Library Deck maintenance. The number of cards in the Library Deck is, obviously, ten times the number of

jobs under the cognizance of the system. The number of revisions which must be merged each week into the Library Deck is a function of the number and nature of jobs involved and must be considered highly variable. An estimate of the magnitude of the Library Deck maintenance task can be made through application of the following assumptions:

1. Full capacity of 125 activated jobs and 115 approved but not activated jobs plus 100 other jobs.

Total is 340 jobs.

2. 40 to 50 jobs in process each week.

3. Average of two to three work centers involved each week on each job in process.

4. 30 to 40 jobs completed each week, an equal number received, and an equal number activated.

5. One job in three requires a special revision each week involving one card.

6. One Shop Schedule/Performance Card in four calls for a revised job estimate.

These assumptions lead to the following rough estimates of activity for certain tasks.

1. Key punch

- a. 450 to 700 cards for new jobs, job activations and other revisions.

- b. 80 to 150 data insertions on Shop Schedule/Performance Cards.

2. Library Deck filing

- a. 30 to 40 insertions of ten-card sets for new jobs and an equal number of removals for completed jobs.
- b. 250 to 350 insertions of all types of revisions with accompanying removals.

3. Update and Test Deck filing

- a. 20 to 40 insertions in each of revisions to be processed.

Computer processing time. Processing time with both Program Schedule and Program Report is primarily a function of the input and output equipment speeds. Since this varies with different models, it must be estimated for a specific installation. There are two exceptions in Program Schedule. First, the read-through of the Library Deck is delayed by sorting and tabulating processes. Second, a calculation of the schedule, during which no input or output occurs, is accomplished at an approximate rate of 80 manhours per second. The provisions for bypassing the card punch routines greatly speed the output phase of Program Schedule in preparing a Tentative Shop Work Schedule.

VI. SUMMARY

The Autosked system is a composite of data preparation and distribution routines and computer programs. Its operation is based upon present organization of the scheduling function. Documents associated with Autosked

replace or supplement those presently in use. The only changes required in existing procedures are minor adjustments to the different data formats.

CHAPTER IV

THE LIBRARY DECK

As has been indicated, the Library Deck is the heart of the Autosked system. It is prepared under the supervision of the master scheduler and is maintained by him or his subordinates. It is anticipated that under Autosked maintenance of the Library Deck would be the primary activity of the master scheduler. In spite of automatic updating provisions which are a part of Autosked, much of the day-to-day posting to, and consultation of, the Library Deck must be on a manual basis.

Figure 5 in Chapter III showed the configuration of a ten-card set describing one job. The use of the ten cards per job format and the placement of the data fields thereon is largely the result of original arbitrary choices. Spacing between data fields, though admittedly wasteful of data space is provided for clarity in manual handling of the Library Deck. This is of primary importance if the Library Deck is to be the exclusive job information source in an emergency requiring reversion to manual scheduling. Further, the Autosked system calls for manual insertion of revision cards which requires ease in reading. The unused space on each Shop Card leaves room to insert additional data, a factor which was of concern in developing the system. The presence of a

separate card for each shop, including those without work on the job, facilitates servicing the Library Deck and was especially helpful in developing the computer programs.

A further description of the data contents of the Library Deck will give additional insight into the Auto-sked system and understanding of the variables considered. Unless otherwise indicated, all data is being developed at some stage in the present work input control process.

Numerical dates, referred to as Julian Dates, are used in the Library Deck because of their computational advantages. A Julian date consists of four digits. The first is the last digit of the year. That is, 4 for 1964, 5 for 1965, etc. The remaining three digits are the number of the day of the year. For example, 1 February is 033 and 29 August is 241 in a 365 day year.

I. MASTER CARD

Figure 11 depicts a Master Card and will be a helpful reference during the following discussion. Paragraph sideheads identify the data fields and the numbers in parenthesis following indicate the numbers of the card columns which contain the data field.

Control Number. (1-5) The first five columns of the Master Card are allowed for the control field. It is intended that this be the same number assigned by the Work Reception Unit when the work requirement first

MASTER CARD

[illegible]

FIGURE 11

MASTER CARD

entered the Operations Division. It is the primary means of identifying the job and is the common element to each of the ten cards in the job set.

Originator Data. (7-17) The originator field is actually a composite of three fields. Columns 7 and 8 are for a two-digit code identifying the originator of the work requirement. The next five positions are allowed for the originator request identification number. The last four positions (14-17) contain the Julian date of the request. This information is used on the Job Listing report. In addition, the percentage of work generated by the Inspection Unit has been of interest to management. Though this project did not include writing a computer program to prepare such a report, it could be done very easily, provided Inspection generated work is identified in this field.

Facility Identification. (19-23) This field contains up to five alphanumeric characters to identify the facility upon which the work is to be performed. This will usually be the facility number but may be a word or abbreviation such as ROADS or GRNDS (grounds) when no particular number applies.

P&E Data. (25-29) This field contains a letter identifying the planner and estimator who handled the job and the Julian date he completed his estimate. This

data is not used in the present study but was included for manual reference purposes. Its inclusion also makes it possible to develop later a program for evaluating P&E performance.

Job Size. (31-39) The Estimated Hours field (31-34) and Material Cost field (36-39) contain information which is not used in the programs developed to date. However, this data may be useful for manual reference. Further, its inclusion makes possible a program to find total cost using only Master Card information. Estimated Hours is the total manhours for all shops. Material cost is in dollars.

Priority Information. (41-51) The Priority (41), Start Date (43-46), and Finish Date (48-51) fields provide information essential to the schedule decision-making process. The priority can be any number 1 through 9. If the job has a committed starting or completion date, this Julian date is entered in the Start Date and/or Finish Date fields. The assignment of a scale of priorities is a departure from current FIFO doctrine described in Chapter I. It is the opinion of the author that a scale of priorities recognizes what has always been actual practice and that FIFO is unsatisfactory as the sole basis for scheduling decisions. The following priority list was used for purposes of this study. It is intended

only as a possible list and is not advocated for universal adoption.

Priority Code	Description
1	Deferral would impair ability to perform mission
2	Deferral would constitute danger to personnel
3	Deferral would constitute danger to property
4	Deferral would interfere with performance of mission
5	Deferral would cause more costly work within one year
6	Deferral would cause level of maintenance to fall below standard
7	Deferral would detract from appearance of installation
8	Deferral is possible for one year without extra cost
9	Work is justified but not essential

Season Code. (53) This field contains a one-digit code indicating the seasonal nature of the job. It recognizes that some work can only be performed at certain times of the year at some locations. The following season codes were used in this study.

Season Code	Description
1	Work can be performed in any season

- | | |
|---|--|
| 2 | Work can be performed in spring,
summer, or fall only |
| 3 | Work can be performed fall,
winter, or spring only |
| 4 | Work can be performed spring
of fall only |
| 5 | Work can be performed in winter
only |
| 6 | Work can be performed in spring
only |
| 7 | Work can be performed in summer
only |
| 8 | Work can be performed in fall only |

Job Status. (55) This field contains a one-digit code to describe the current status of the job. This is used in preparing the Job Listing through Program Report which causes the printing of the status description associated with the code. This code is used by Program Schedule and Program Report in sorting jobs. Further, it is used in the decision mechanisms of Program Schedule which place varying emphasis for scheduling upon each status code. The following status codes were used in this study.

Status Code	Description
1	Scheduled job
2	Previously scheduled but deferred for more urgent work
3	Activated, awaiting scheduling
4	Activated, held for material

- | | |
|---|---|
| 5 | In approved backlog awaiting activation |
| 6 | Pending approval of higher authority |
| 7 | Reimbursable work pending approval of requestor |
| 8 | Deferred pending job amendment |
| 9 | Deferred by maintenance officer |

Fund Information. (57-62) This field consists of two parts, the Fund Source Code (57) and the Job Order Number (58-62). The fund source is, as previously mentioned, one of the primary scheduling parameters. The job order number is of little significance to this study. However, it has been included for illustrative purposes since it is a primary concern in the present cost and allotment accounting procedures. Provision for its inclusion here provides a bridge for translation of data between the accounting system based upon the job order number and the scheduling system keyed to the control number.

Date Activated. (64-67) This field contains the Julian date of activation of the job, the date the job order was approved. This date is the one used in applying the FIFO criteria in the scheduling payoff formula.

Related Control Number. (69-79) Two five position fields are provided for related control numbers. This is an aid to the scheduler and users of the Job Listing report

in identifying other work requirements which are related to, or included within, this given work requirement (control number). For example, in the job planning process work requirements that were originally separately identified may be combined into one job.

Master Card Identification. (80) Card column 80 always contains the digit "1" to identify it as a Master Card. Both Program Report and Program Schedule have provisions for stops if cards appear out of sequence.

II. JOB DESCRIPTION CARD

The Job Description Card contains only three data fields. The control number field (1-5) is the same as appears on all cards of the set. Column 7 always contains the letter "D" to identify the card as a Job Description Card in the sequence checking routines of the computer programs. The remainder of the card (9-80) is available for a short alphanumeric description of the work involved on the job.

III. SHOP CARDS

Each of the eight Shop Cards is prepared in the same format. If any particular field of data is not pertinent to a job, it is left blank or punched with zeros. Thus, a Shop Card for a work center which did not have work on the job would contain only the control

number and the work center number. Figure 12 depicts a Shop Card and identifies the data fields. Again, in the following discussion, paragraph sideheads name the data fields and the numbers following indicate the card columns containing the data.

Control Number. (1-5) Again, the control number appears in the same field as on other cards of the ten-card set.

Work Center. (7) Column 7 contains a single digit identifying the work center associated with the card.

Estimated Hours. (9-12) This field contains the number of hours of work estimated for the work center. This is maintained as a constant point of reference. Though a program was not developed as a part of this study, this data would be necessary in analyzing performance variance from estimates.

Estimated Workdays. (14-16) This field contains the estimated number of working days required for the shop to complete the job. This is, of course, a function of the crew size which is, in turn, a function of the nature of the work. This data is not presently well developed in job estimates. However, it can be obtained with little additional effort since crew size and job duration

SHOP CARD

assumptions are a part of engineered performance standards. As in the case of the Estimated Hours field, this field serves as a point of reference. Again, it would be essential in a program to analyze performance variances.

Weather Code. (18) This field contains information on job sensitivity to precipitation. Though this consideration can occasionally assume major importance in the schedule, it was not feasible to include it in the normal decision mechanisms. However, this information was included on the Shop Card so that, when made necessary by weather, the Library Deck could be used manually to find alternate work. The following weather codes were used in this study.

Weather Code	Description
1	Work is insensitive to precipitation
2	Work can only be done in dry weather
3	Work can only be done in wet weather

Work sequence data. (20-24) The Blocking Shop (20) and Per Cent Blocked (22-24) fields contain data essential to the work scheduling logic. As indicated in Chapter I, some jobs can be worked by all shops concurrently while others must be worked sequentially by all or some work centers. The Blocking Shop field holds the number of the work center, if any, which must complete some of its

work before the shop in question can commence work. Although several shops may have to complete work before the blocked shop can work, the shop causing the latest occurring, or most immediate, block is designated the blocking shop. The Per Cent Blocked field gives the percentage of its work the blocking shop must complete before the blocked shop can start. Referring to Figure 11 which is the Shop Card for Work Center #3, Work Center #2 blocks #3 from working until #2 has completed 90% of its total work. This data is not presently included in this form in current job estimates. However, work sequence must be considered by the P&E in developing the job plan. Therefore, identification of this data in the job estimates should present no additional burden. It should be noted that the P&E need specify only the individual blocks and their duration. The analysis of these blocks is performed by the computer and will be discussed in Chapter V.

Material data. (26-31) The Material Code (26) and Date Material Due (28-31) fields serve as reference points for manually consulted data. In addition, the material status is used in the scheduling logic to determine whether a work center could be scheduled for work or must be held up for material. It was originally contemplated that the date material is expected would be used as a refinement in Program Schedule. This was discarded, however, in view

of the general uncertainty associated with material delivery dates and the special inputs which would have been required. The following material status codes were used in this study. Their significance is discussed in Chapter V.

Material Code	Description
0	No material is required
1	Material is on hand
2	Requires material in local stock
3	Requires material through Marine Corps supply channels
4	Requires open purchase material

Hours Expended. (33-36) This field is blank or zero when the Shop Card is initially prepared. As work is completed and reported via Shop Schedule/Performance Cards, the manhours are added to this field through the operation of Program Schedule.

Hours Remaining. (38-41) This field contains the number of labor manhours remaining for the work center to complete its part of the job. When the Shop Card is prepared, this field will equal the Estimated Hours field. As the job progresses, this field is decreased through operation of Program Schedule based upon data reported on Shop Schedule/Performance Cards.

Workdays Remaining. (43-45) This field is initially equal to the Estimated Workdays field. Like the Hours Remaining field, it decreases as the job is performed. The combination of these two fields determines the rate at which labor can be applied to a job and are key factors in the scheduling logic.

This completes the description of data contained in the Library Deck. It will be noted that on all cards there is some data that is not used in the Autosked system as presently programmed. In addition, the Shop cards have a limited number of unused columns. Thus, even more data than that now carried could be accomodated.

IV. SHOP SCHEDULE/PERFORMANCE CARD

The Shop Schedule/Performance Card is not a part of the Library Deck. However, it should be noted that this card contains all the data fields of a Shop Card plus three additional fields. As has been explained, it is prepared during the execution of Program Schedule. A Shop Schedule/Performance Card was depicted in Figure 7 in Chapter III.

Hours Scheduled. (47-50) This field contains the number of manhours which the work center is to apply to the job during the week.

Hours Completed. (52-55) This field is blank when the card is delivered to the work center. At the end of the work week the number of manhours worked on the job is entered on the card by the shop supervisor. This is then punched into the field before the card becomes a part of the Update Deck.

Date. (57-73) This field carries the calendar date of the last working day of the week. This provides identification so that cards for different weeks will not be confused.

CHAPTER V

SCHEDULING LOGIC

To this point only general reference has been made to the work scheduling logic derived from this study and incorporated into Program Schedule. This chapter is devoted to a description of the salient points of Program Schedule and the rationale behind their treatment. Though Appendix A contains flow charts and detailed block diagrams, selected flow charts have been included here to clarify the points being discussed. Figure 13 is a general flow diagram of the entire Program Schedule logic.

I. PRELIMINARY SCREENING

In arriving at the Shop Work Schedule (or Tentative Schedule) the full Library Deck is searched job by job. This, of itself, is an important aspect of an ADP oriented system. That is, all activated jobs are examined and considered for scheduling, a task which could be accomplished only with the most extensively manned manual systems.

The first order of business as each job is considered is to post revisions carried on the Update Tape. Also, on this first pass through the jobs it is possible to reject certain jobs from further consideration. These are:

1. Those whose committed starting date has not yet occurred and will not occur during the week being

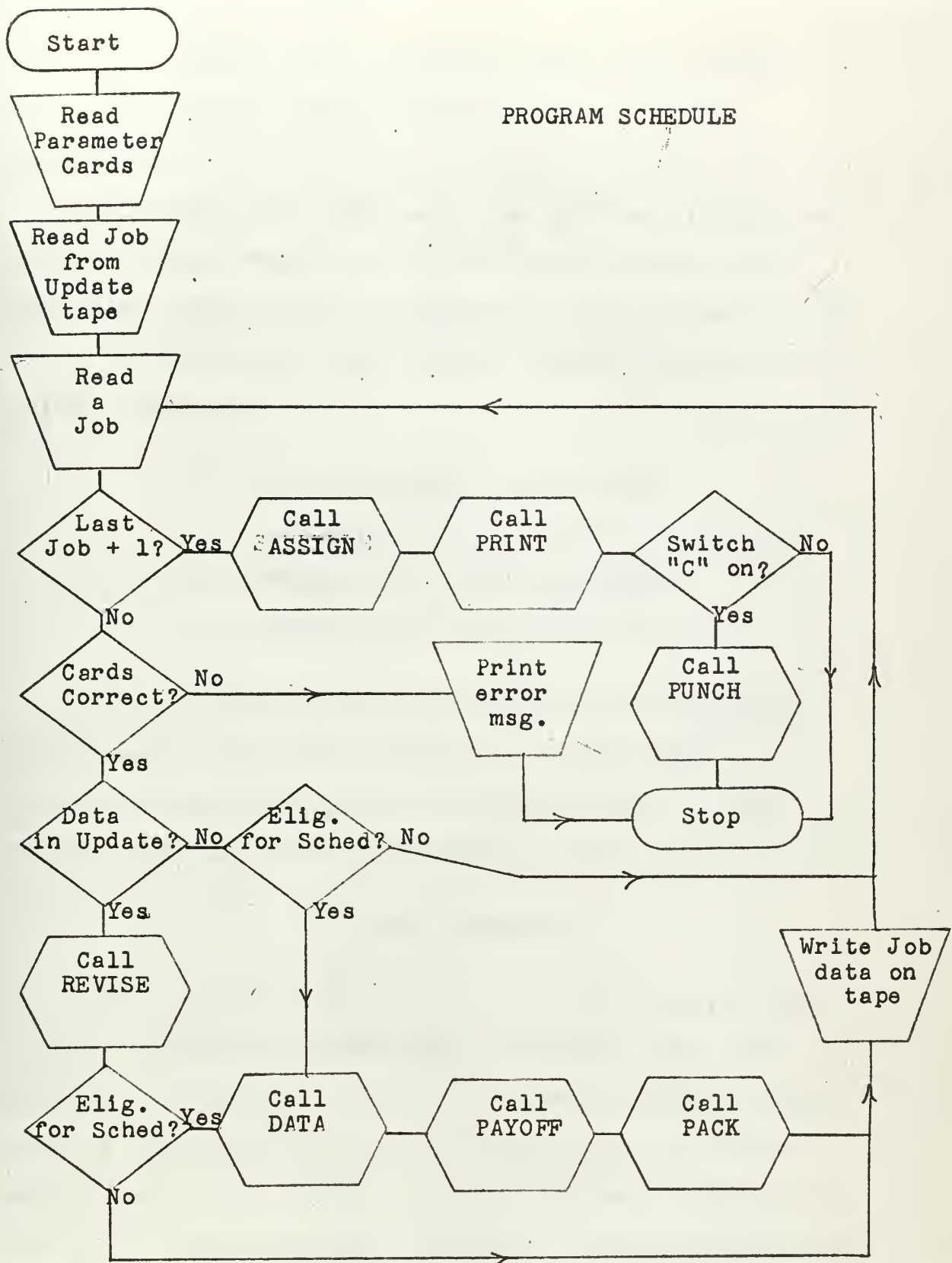


FIGURE 13

PROGRAM SCHEDULE FLOW CHART

scheduled. Specifically, these are jobs with a Julian start date greater than the Julian date of the last working date.

2. Those jobs that cannot be performed during the current season. These are the jobs with a season code other than those given as acceptable on the parameter card.

3. Those jobs whose current status precludes scheduling. These are:

- a. Status 4--Held for material
- b. Status 5--In backlog, not activated
- c. Status 6 & 7--Pending approval
- d. Status 8 & 9--Deferred for cause

Jobs by-passed for scheduling are not considered further unless they were involved in a data update. In this case certain job data is retained on tape so that revised cards can later be punched for the Library Deck.

II. WORK ANALYSIS

All jobs surviving the initial screening are considered eligible for scheduling. Therefore, they are analyzed to calculate the maximum number of manhours that could be performed by each work center during the forthcoming week. This is done in Subroutine Data depicted in Figure 14. The significant variables in the consideration are:

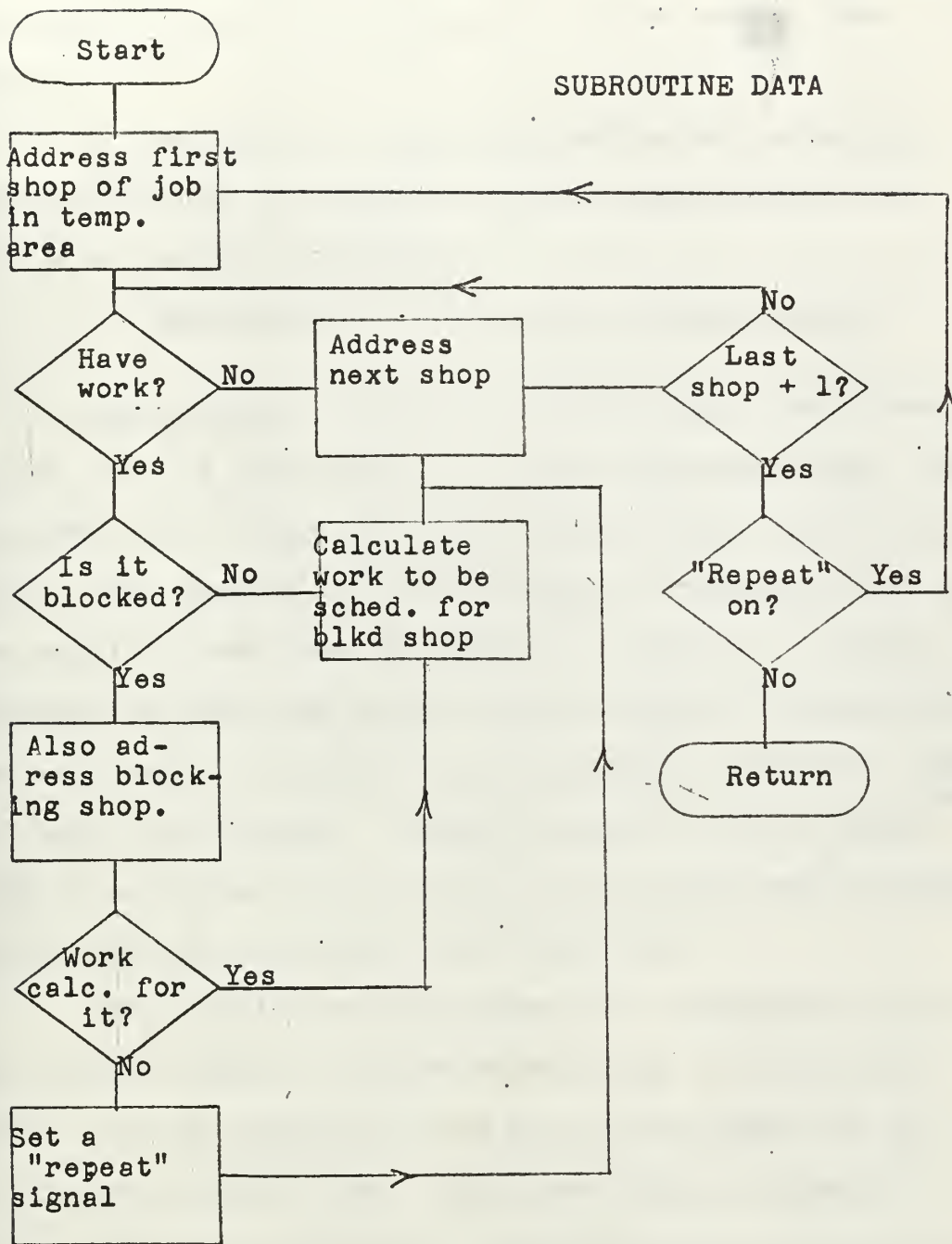


FIGURE 14
SUBROUTINE DATA FLOW CHART

1. The number of workdays in the week. This information is provided on one of the parameter card inputs.

2. The rate at which the job can be worked as calculated from the manhours of work remaining and the number of workdays remaining.

3. The presence of "blocks" by other shops.

The problems presented by the latter, the "blocks", are by far the most complex of these considerations. The procedure for coping with these blocks merits some explanation. The essence of the procedure is determination of the critical work path prevailing in the job. That is, the sequence in which the shops should commence work and the earliest point, in terms of working hours scheduled, that the shop can commence. Identification of the critical path is made possible by shop work sequence data provided by the P&E and included on each Shop Card.

Shops which are not blocked are considered first. The maximum number of hours scheduleable is calculated based upon the number of work days in the week and the calculated working rate. The entry point or number of work hours which must have elapsed during the week before the shop can start work is zero for these shops.

Shops which are blocked by one of the first group of shops are next considered. By applying the blocking

the first of these is the fact that the first of the two
 paragraphs is a complete sentence, while the second is a
 fragment.

The second of these is the fact that the first of the two
 paragraphs is a complete sentence, while the second is a
 fragment.

The third of these is the fact that the first of the two
 paragraphs is a complete sentence, while the second is a
 fragment.

The fourth of these is the fact that the first of the two
 paragraphs is a complete sentence, while the second is a
 fragment.

The fifth of these is the fact that the first of the two
 paragraphs is a complete sentence, while the second is a
 fragment.

The sixth of these is the fact that the first of the two
 paragraphs is a complete sentence, while the second is a
 fragment.

per cent to the number of hours estimated for the blocking shop, the point in the total job at which the blocked shop can start work is determined. This quantity is then used to determine whether or not the blocked shop can start during the week. If the blocked shop can be scheduled, the entry point and the number of available work days (to 0.1 day) are computed. This data is then used to calculate the maximum number of manhours which can be scheduled.

This process is repeated until the number of working days, the working rate, the maximum number of hours, and the entry point have been calculated for each shop. Of this data, the entry point and maximum scheduleable hours for each shop are of concern in the scheduling algorithm. Therefore, this information, together with a blank field for recording the number of hours actually scheduled, is stored in a table in core memory. The control number and fund source code are also placed with the other job data in the matrix.

III. PAYOFF CALCULATION

The next major task is determination of the sequence in which jobs should be brought into the work schedule. Some mention has already been made of the factors bearing upon this decision. These factors and their general impact are:

1. Job priority. The higher priority the job, the more important that it be scheduled promptly.

2. Job status. Other things being equal, jobs already on the schedule or previously started should be completed before new jobs are undertaken.

3. Deadline commitments. Every effort consistent with other priority considerations should be made to complete jobs by committed completion dates.

4. Age of job. All other factors being equal, the older jobs should be completed before new jobs. That is, first in, first out (FIFO).

A payoff formula was incorporated into Program Schedule to give selected weights to these factors in rank ordering the jobs. This formula is:

$$Y = \frac{A}{X_1} + \frac{B}{X_2} + \frac{C}{X_3} + DX_4 \quad \text{where,}$$

Y = A payoff number for the job

X_1 = The job priority code (1 to 9 possible)

X_2 = The job status code (1, 2, 3, and 5 are used)

X_3 = The number of days until the committed finish date

X_4 = The number of days since the job was activated

A, B, C, & D = Constants which are introduced on the parameter cards and whose value may be adjusted

Using this criteria, the jobs with the highest payoff are scheduled first. To facilitate this procedure,

jobs are entered into the core memory table in descending payoff number sequence. Thus, as the payoff for each job is determined, this table is rearranged as necessary to fit the job into its proper position.

Once a job has been entered in the table, basic job data is written on tape. This will be consulted later, and, if the job is placed on the schedule, will provide data for punching new cards for the Library Deck and Shop Schedule/Performance Cards.

SCHEDULING ALGORITHM

After all eligible jobs have been analyzed and entered into the core memory table, the actual work scheduling operation can begin. The scheduling algorithm accomplishes this one manhour at a time. Figure 15 is a flow chart of the process. The first work center of the highest payoff job (this is the first in the table) is addressed first and the following questions tested:

1. Do fund limitations permit scheduling any work on this job? On the first pass through the matrix this limitation is the minimum established for each fund source. If the answer is affirmative, the next test is made. If negative, the next job is addressed.
2. Can this shop accept work? If the answer is affirmative, the next test is made. If negative, the next shop is addressed.

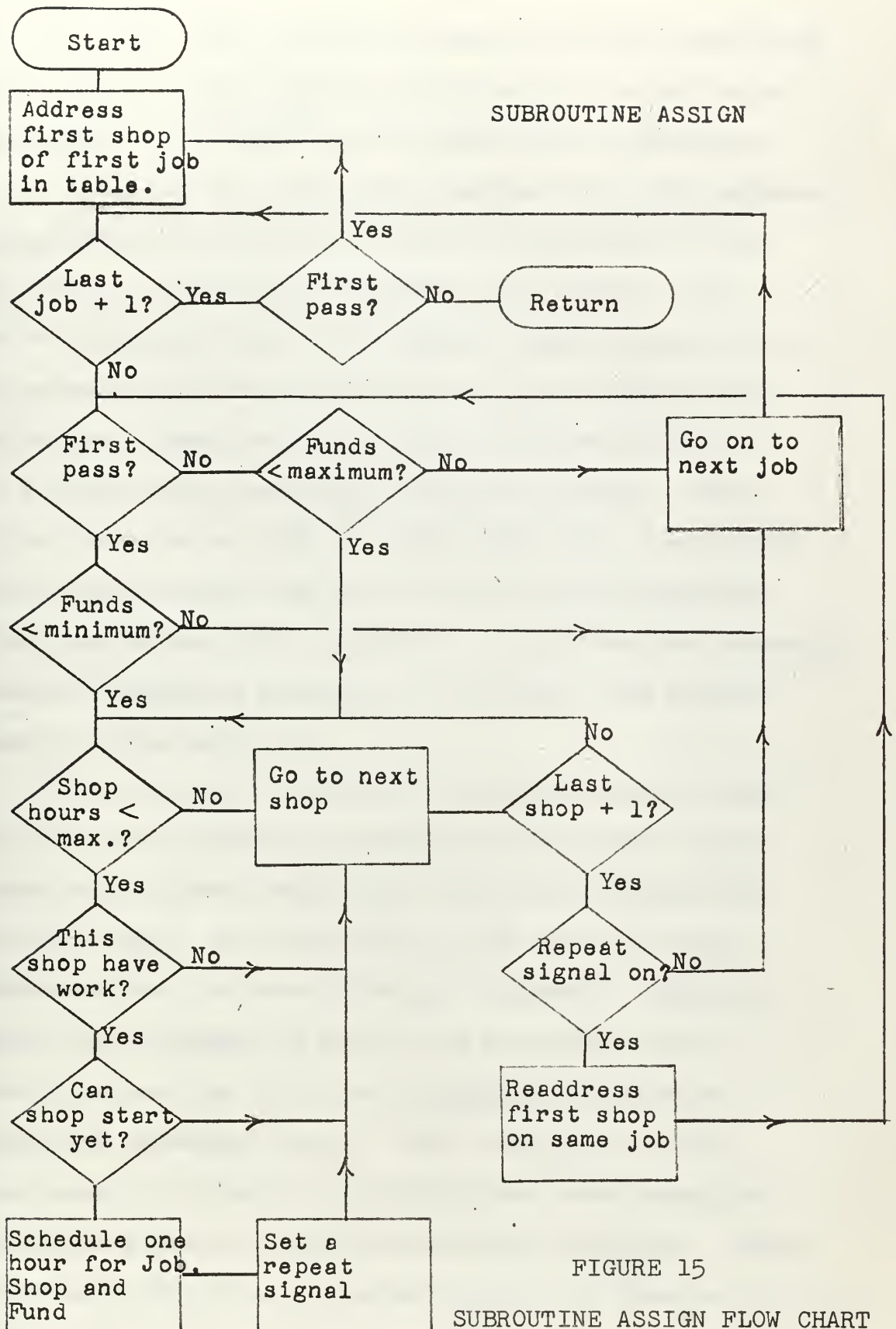


FIGURE 15

SUBROUTINE ASSIGN FLOW CHART

3. Does this shop have scheduleable work remaining on this job? If the answer is affirmative the next step is performed. If negative, the next shop is addressed.

If all of the foregoing questions have been answered affirmatively, one manhour of work is scheduled for the shop, the job, and the appropriate fund source. This involves adding to the work scheduled field in the table, and special registers established for each shop and each fund source. The next work center on the same job is then addressed and the above questions repeated. When the last work center (#8) has been addressed, the process returns to #1 on the same job if any work was scheduled on the pass-through just completed. If no work was scheduled (because of negative answers to the tests), the process proceeds to the next job.

This procedure continues through the matrix until sufficient work has been scheduled for each fund source to meet the minimums which were established through the parameter cards. The first job in the matrix is then readdressed and the same procedures followed. However, on this pass through the matrix the applicable fund limitations are the fund source maximums interjected through the parameter cards. Upon completion of this second pass, all possible work will have been scheduled and Program Schedule turns to the output routines. These outputs were described and examples given in Chapter III.

CHAPTER VI

REFINEMENTS AND CONCLUSIONS

Though the system developed herein is considered useable at most Marine Corps installations with certain adaptations, it must not be viewed as a finished product. It is a reasonable first approximation but will certainly require refinement. Some of the unsolved problems and potential refinements are discussed below.

I. SYSTEM TEST

Autosked was exercised in a test simulating six weeks of work scheduling. This test was based upon a Library Deck of 92 jobs representing a sampling of actual maintenance and repair job information. Job data was extracted from copies of job orders issued by the maintenance department of a large Marine Corps installation. Information not available on the job orders but desired in the Library Deck was simulated. Shop manpower availability and fund constraints were simulated for purposes of the test. Appendix C lists the parameters used in the test, reports processing details, and presents samples of the outputs generated.

It must be recognized that this test accomplished little more than a necessary program diagnosis and illustration of outputs. The only satisfactory test of Autosked

would be actual scheduling of actual work in parallel with the present manual procedure. Only in this way could the shortcomings and advantages be accurately measured. Such a test would confirm or eliminate the requirement for refinements suggested below.

II. REFINEMENTS

Job selection. No computer program has been developed for selecting work to be activated from the backlog of jobs. It was originally contemplated that such a program would be included in Autosked. However, realization of this objective was thwarted by excessive time required to obtain success with the programs presented. The author's lack of proficiency with the SPS programming was the primary cause of excessive time in program debugging.

Autosked is handicapped but not crippled without this backlog selection program. Such a program should present few problems (other than time). The required output would be a simple listing of the control numbers of the jobs recommended for activation. The decision criteria would be based upon constraints similar to those in Program Schedule. However, the decision should be simplified since it would be in terms of entire jobs rather than individual manhours. All data required for the decision is contained in the Library Deck or could

be introduced via the parameter cards.

System dimension limitations. It would be expected that the present system dimensions would become a problem in any large-scale scheduling operation. The 125 active job limit of Program Schedule is most easily dealt with. Since this limit is imposed by the capacity of a core memory table, and since jobs are stored in this table in descending order of payoff, a simple programming addition would provide that only the top 125 jobs be stored. Those not fitting into the top 125 would be "cast off". This pool of 125 jobs should be most adequate as a base from which the immediate schedule will be drawn.

It must be recognized that program additions would tend to reduce the present 125 capacity. However, in any reprogramming there is considerable potential for refining the present program to recapture core storage capacity.

The limitations are tighter with Program Report. A system with 125 activated jobs would probably be backed up by a pool of approved jobs awaiting activation much greater than the 115 which could be accommodated within the 240 limitation discussed in Chapter III. Fortunately, the situation can be rather easily relieved by using magnetic tape storage. Though Program Schedule requires two tape units in its execution, none are presently required by Program Report and are thus available for use as additional storage. The processing sequence of

Program Report lends itself to tape storage.

Servicing the Library Deck. As presently programmed, the Autosked system relies heavily upon manual placement of new and revised cards and removal of superceded cards in the Library Deck. Unquestionably, this reliance is a potential source of errors. Although the computer programs have provisions for detecting cards erroneously inserted in the Library Deck, the processing stops which result might become so numerous as to impair the value of the Autosked system. Each processing stop requires specific action to correct the error. If data for correction of the error is not available in the computer center or the time for correction cannot be spared, the job or jobs involved may have to be by-passed.

An alternative to manual insertion of revision cards would be the automatic generation of a new Library Deck weekly with the execution of Program Schedule. The constraint in this case is the availability and cost of the computer processing time to punch a new deck at the 250 card per minute rate of the IBM 1402 Card Read-Punch. Provided the processing time is available, this refinement of Autosked should be adopted at the outset.

Payoff formula. The payoff formula used in ranking jobs is untried. To serve its intended purpose, the payoff must be a reliable quantitative expression of the relative

worth of each job. If used for any purpose other than rank ordering jobs such as in a payoff maximizing criteria discussed under the next topic, the payoff must reflect the utility of working an hour on a particular job relative to the utility of working an hour on any other job.

The simple inverse and direct relationships may not adequately weight the payoff factors. Though some adjustment is possible through the choice of constants used, there is no provision for altering the degree of the payoff terms. In addition, it may be that other variables should be brought to bear in the payoff formula. A study aimed at identification of the proper variables and their multiple correlation with payoff is needed.

Scheduling algorithm. The two-pass scheduling algorithm of Program Schedule is elementary and provides only a solution. This may or may not be the best solution. Results of the limited system test suggest that the two-pass consideration may be inadequate for practical use.

Certain job configurations can cause failure to schedule minimum work for a fund source or work center though work is available. This is considered a serious defect in the case of the fund source since it is a failure to meet an established constraint. Failure to fully commit a work center may be justified if the only work available to the shop is from a fund source which has been fully committed to other shops on higher payoff work. Such a

case becomes a question of relative importance, a function of the payoff. Some refinements in this area have been programmed but were not ready for inclusion in this report.

At the outset of this project the author was desirous of applying a maximizing algorithm. This is part of the basis for use of a payoff. However, the scheduling system considered herein is more complex than those susceptible to the traditional linear programming techniques. In short, the author chose to emphasize the total system and was unable to adapt a maximizing criteria. From this discussion it can be seen that the refinement of the scheduling algorithm is, of itself, a suitable subject for extensive research. It is especially recommended for the mathematically inclined.

Multiple copies of outputs. The computer programs in Autosked produce a single copy of printed outputs. Additional copies can, of course, be obtained in a single printing by the use of multi-copy printer paper. However, this would not be adequate for the minimum of ten copies that would be required for an organization with eight shops. Where other means for rapid reproduction are not available, the programs could be modified to provide several executions of the output routines. This could not be done in the case of the Job Listing without resort to intermediate tape storage since this report is printed as the Library Deck is read.

Scope of the system. Autosked has been oriented toward scheduling specific maintenance jobs. As has been mentioned, not all of the labor in the work center is applied to this type of work. Relatively predictable amounts of the weekly labor total are applied to supervision, overhead, leave, emergency/service work, preventive maintenance, and fixed job assignments. It is entirely feasible that these could be included in the Autosked system by treating them as specific jobs and inserting appropriate data in the Library Deck. It would be necessary to assign payoff factors such that inclusion on the weekly Shop Work Schedule would be assured.

Override provision. As was suggested in the previous paragraph, inclusion on the Shop Work Schedule can be assured by artificial adjustment of the factors which are involved in the payoff computation. If such artificialities are objectionable, an easily accomplished refinement would be provision for scheduling selected jobs, including those of the type discussed in the previous paragraph, by a special priority code. This would cause an overriding of the usual payoff calculation.

Management reports. Computer outputs have been kept to the minimum considered necessary to operate the Autosked system. The range of information stored in the Library Deck makes possible a large variety of other reports to

management. Some of these such as P&E performance, percentage of work generated by inspection, and performance variance analysis have already been mentioned. The requirement for and format of these or other possible outputs is a local consideration.

III. CONCLUSION

This study has convinced the author that automated scheduling of real property maintenance work at Marine Corps installations is feasible and worthy of further development. The attractiveness of Autosked lies not in immediate cost savings but in its enhancement of one presently lagging aspect of the Maintenance Management Program. Specific benefits to be realized from a computer based system such as Autosked are:

1. An economical means of coping with the increasing constraints which must be considered in the work scheduling process. The equipment and personnel for such a system are presently available.

2. The automation of clerical tasks now requiring much of the master scheduler's time. This permits him to concentrate more on the longer range aspects of work planning.

3. Uniform application of predetermined and well defined scheduling criteria. This avoids much of the subjectivity of the present system.

4. All jobs are screened in arriving at any decision. This enhances work input control and minimizes the opportunity for administrative oversights.

5. Work backlog information is maintained current and readily available. The substantial effort required in manual preparation of backlog reports is eliminated.

The recommended course of further development would be a pilot project using Autosked as a point of departure. Initially, the pilot project should parallel an existing manual master scheduling operation.

Whatever the ultimate disposition of Autosked, its development has led the author to a special appreciation for the problems in application of ADP to the maintenance management system. This would seem capable of generalization to other efforts to automate management systems.

The most cogent result has been the conclusion that a manager must be sufficiently familiar with ADP hardware and software capabilities and limitations to recognize potential applications in systems under his control. A passing acquaintance is inadequate. While experts can be consulted, the problem must be well understood and defined before the call is issued if the time of the expert is to be spent profitably. The manager need not be a computer programmer, but he must be familiar with programming considerations to be realistic in his expectations and in his communication with the experts.

This conclusion carries a mandate to Marine Corps managers of administrative and, eventually, operational systems. While a team of ADP experts is being developed, this group cannot address itself adequately to the recognition of applications. A conscious effort is required to familiarize middle and top managers with ADP so that they can perform this function.

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BIBLIOGRAPHY

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APPENDIXES

APPENDIX A

PROGRAM SCHEDULE

I. General

This program, written in the SPS language, prepares a printed work schedule of jobs under cognizance of the Autosked system. It generates three types of punched cards which serve as work directives to the shops, revisions to the data library, and a source of data for preparing tentative schedules. This same program, by changing sense switch settings, can be used to prepare normal or tentative schedules. A magnetic tape containing updating information is a necessary input source. Details for its preparation are included herein. A second tape serves as a temporary file during execution of the program. A general discussion of program inputs, outputs, and operation are contained in the basic text.

II. Machine Requirements

A. Hardware. The basic requirement is an IBM 1401 data processing system. The processing unit must have a 16,000 character storage capacity. A read-punch, printer, and two tape units are required.

B. Special features. In addition to the 16,000 character storage, the following special features are used:

1. Multiply-divide
2. High, low, equal compare

3. Indexing
4. Store address register
5. Move record
6. Sense switches

C. Core storage. The program requires approximately 5400 positions of core storage. In addition, each job considered for scheduling and entered into the core storage table requires 83 positions. Thus, the maximum number of jobs which could be considered is 125.

III. Processing

A. Update Deck. The Update Deck is processed first. This requires a card-to-tape program for Tape Unit #1. If a schedule is to be prepared immediately, the tape may be left mounted on Unit #1. The Update Deck is not needed once this tape has been prepared and can be discarded.

B. Program Schedule.

1. The condensed program deck precedes the Library Deck in the read hopper.

2. The Update Tape is mounted on Unit #1 and a scratch tape on Unit #2.

3. Punch must be "On" and hopper loaded with Shop Schedule/Performance Cards unless punching is by-passed.

4. Sense Switch B is "On" if punched card outputs are desired and is "Off" if punch routines are to be by-passed.

5. Sense Switch C is "On" if normal Shop Work Schedule is desired and is "Off" when preparing a Tentative Schedule.

6. Stops occur if cards are detected out of sequence. A message giving the source of the error and restart procedures is printed.

7. Completion is signaled by a printed message.

IV. Card Deck Preparation

A. Update Deck. The Update Deck must be assembled in control number sequence. In addition, within a control number set, the cards must appear in the following sequence, if they are present, when preparing a normal schedule.

1. Master Card revisions (any number).
2. Shop Schedule/Performance Card for Work Center #1.
3. Revision cards for Work Center #1 (any number).
4. Shop Schedule/Performance Card for Work Center #2.
5. Revision cards for Work Center #2.
6. Same as above for all eight work centers.

Only special input cards, arranged in control number sequence, are used when preparing a tentative schedule.

B. Library Deck. The Library Deck and added parameter cards are assembled in the following sequence.

5. Sense Switch C is "On" if normal Shop Work Schedule is desired and is "Off" when preparing a Tentative Schedule.

6. Stops occur if cards are detected out of sequence. A message giving the source of the error and restart procedures is printed.

7. Completion is signaled by a printed message.

IV. Card Deck Preparation

A. Update Deck. The Update Deck must be assembled in control number sequence. In addition, within a control number set, the cards must appear in the following sequence, if they are present, when preparing a normal schedule.

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2. Shop Schedule/Performance Card for Work Center #1.

3. Revision cards for Work Center #1 (any number).

4. Shop Schedule/Performance Card for Work Center #2.

5. Revision cards for Work Center #2.

6. Same as above for all eight work centers.

Only special input cards, arranged in control number sequence, are used when preparing a tentative schedule.

B. Library Deck. The Library Deck and added parameter cards are assembled in the following sequence.

1. Date Card. Gives the Julian date of the first and last working days of the week being scheduled, the number of working days in the week and the calendar date of the last day of the week. These are punched as follows:

Card Columns	Description
1	The last digit of the year associated with the first day of the week (e.g., 1965 is coded as 5)
2-4	The 3-digit Julian date of the first working day
5	The last digit of the year associated with the last working day of the week
6-8	The Julian date of the last working day
9	The number of workdays in the week
10-26	The calendar date of the last day of the week (e.g., 20 May 1965)

2. Season/Payoff Constant Card. This card carries information on which season codes can be scheduled. It also inputs the constants used in the calculation of job payoffs. The card is punched as follows:

Card Columns	Description
1-5	Up to 5 season codes which may be scheduled are entered beginning in Column 1
6-8	The constant to be used in computing the job priority contribution to job payoff
9-11	Same as above but for status
12-14	Same as above but for finish date
15-17	Same as above but for job age

3. Fund Minimum Card. Gives the minimum number of manhours to be scheduled for each of the eight possible fund sources. Data is punched as follows:

Card Columns	Description
1-4	Minimum manhours for Fund Source 1
5-8	Minimum manhours for Fund Source 2
9-32	Same as above with fields of 4 digits for each of 8 fund sources

4. Fund Maximum Card. Gives the maximum number of manhours to be scheduled for each of the eight possible fund sources. Data is punched as follows:

Card Columns	Description
1-4	Maximum manhours for Fund Source 1
5-8	Maximum manhours for Fund Source 2
9-32	Same as above with fields of 4 digits for each of 8 fund sources

5. Work Center Manpower Card. Gives the number of manhours to be scheduled for each of the eight work centers. Data is punched as follows:

Card Columns	Description
1-4	Manhours for Work Center #1
5-8	Manhours for Work Center #2
9-32	Same as above with fields of 4 digits for each of 8 work centers

6. The Library Deck in the sequence maintained.

7. A blank card to signal the end of the data.

V. Block Diagram and Flow Charts

The block diagram which follows depicts the program logic and also serves as a SPS program listing. The glossary preceding the diagram identifies the labels used. Flow charts of general program logic follow the block diagram.

Label	Definition
ASTER	An Asterisk
BLANK	Field of 4 blanks
CON__	A numerical constant
CONSNT	A reference point for the payoff constants
CONT__	A jump in the program
COUNT_	Counters for the number of jobs processed
DASHES	Two dashes indicating no work for the shop
DATA	The start of the routine for computing hours available for scheduling
DATE	The calendar date
DAYS	Number of workdays available for a particular job
ENTRY	Number of hours which must have been worked on a job during a given week before a particular shop can start work
ERNOT_	Alphanumeric error message
ERRSTP	Routine for stopping if an error is detected
FIN	Notation that the shop has finished work on a job
FNDMAX	The prescribed maximum manhours to be committed from a given fund source in a given week

Label	Definition
FNDMIN	The prescribed minimum manhours to be committed from a given fund source in a given week
FNDREG	A register for accumulating the hours scheduled for each fund source
FOOT_	Alphanumeric footings for the schedule
FUND	A counter for recording the fund source under consideration
GRPMRK	A group mark with a word mark
HCOUNT	A counter for accumulating the number of hours scheduled for a job during the given week
HEAD_	Alphanumeric headings for the schedule
JOBEND	Words "Job Completed"
LIMIND	A signal to indicate which fund limitation applies
LINECT	Count of the number of lines of printing used
NEWJOB	Start point of the routine for processing one job
NOTE	Alphanumeric message of insufficient work
NOTIND	Signal to indicate NOTE is required
PACK	Routine for placing data in TABLE from TEMP
PAGECT	Count of the number of pages printed
PAYCLC	Routine for computing PAYOFF
PAYOFF	Total payoff for a job
PRINT	Starting point for the output routines
READ	A routine for reading cards and stacking
RECMRK	A record mark

Label	Definition
REPEAT	A signal that at least one hour was scheduled on a pass through a job
REVISE	Routine for reading from Update Tape
SCHED	Start of the work commitment routines
SCRUB	Tape error routine
SEQ	An indicator of the sequence in which a job is worked
SETMRK	Routine for setting word marks
SHIFTA	Routine for shifting jobs within TABLE
TABLE	Reference point for core storage table of job data
TAPERR	Tape error routine
TEMP	Reference point for job data work area
TENT	The word "Tentative"
UPDATE	Reference point for updating data area
WAIT	Storage point for index contents
WCCT	Counter for work centers
WCMAX	The prescribed manhours to be scheduled for a given work center
WCREG	A register to accumulate hours scheduled for each work center
WRTAPE	Routine to write TEMP on tape #2
WORK_	Work area for computations
ZERO	A field of 4 zeros

[illegible]

			1	2	3	4	5	6	7	8	9	10	
2 093		***** *MU (U) UPDATE +001 R* *****	A	A	V	V							
		1	A	A	V	V							
		1	A	A	V	V							
		1	A	A	V	V							
2 094		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *H LASTD XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	A	A	V	V	V						
		1	A	A	V	V	V						
		1	A	A	V	V	V						
		1	A	A	V	V	V						
		1	A	A	V	V	V						
2 095	SCRUB	***** *MCW ZERO UPDATE +005 *****	A	A	V								
		1	A	A	V								
		1	A	A	V								
		1	A	A	V								
		1	A	A	V								
2 096	LASTD	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *B 0000 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	A	A	V								
		1	A	A	V								
		1	A	A	V								
		1	A	A	V								
		1	A	A	V								
2 100	CONTR	***** *B REVISE *****	A	A									
		1	A	A									
		1	A	A									
		1	A	A									
		1	A	A									
2 101		***** *LCA GRPMRK TEMP +498 *****	A	A									
		1	A	A									
		1	A	A									
		1	A	A									
		1	A	A									
2 110	NEWJOB	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *B READ XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	A	A	A								
		1	A	A	A								
		1	A	A	A								
		1	A	A	A								
		1	A	A	A								
2 111		***** *B SCHED 0005 *****	A	A	A	V							
		1	A	A	A	V							
		1	A	A	A	V							
		1	A	A	A	V							
		1	A	A	A	V							
2 120		***** *B CONTRD 0000 *****	A	A	A	V	V						
		1	A	A	A	V	V						
		1	A	A	A	V	V						
		1	A	A	A	V	V						
		1	A	A	A	V	V						
2 130	ERRSTP	***** *CC *MCW ERNOT 1 0209 *CC *W *MCW ERNOT 2 0302 *CC *W *CS 0332 *CS *MCW ERNOT 3 0407 *CC *W *CS 0299 *SW 0001 *****	A	A	A	V	V	A					
2 140		1	A	A	A	V	V	V	A				
2 141		1	A	A	A	V	V	V	A				
2 150		1	A	A	A	V	V	V	A				
2 160		1	A	A	A	V	V	V	A				
3 000		1	A	A	A	V	V	V	A				
3 010		1	A	A	A	V	V	V	A				
3 020		1	A	A	A	V	V	V	A				
3 030		1	A	A	A	V	V	V	A				
3 040		1	A	A	A	V	V	V	A				
3 060		1	A	A	A	V	V	V	A				
3 070		1	A	A	A	V	V	V	A				
3 090		1	A	A	A	V	V	V	A				
3 090		1	A	A	A	V	V	V	A				
3 100		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *H NEWJOB XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	A	A	A	V	V	V	A				
		1	A	A	A	V	V	V	A				
		1	A	A	A	V	V	V	A				
		1	A	A	A	V	V	V	A				
		1	A	A	A	V	V	V	A				
3 110	CONTRD	***** *C 0055 *****	A	A	A	V							
		1	A	A	A	V							
		1	A	A	A	V							
		1	A	A	A	V							
		1	A	A	A	V							

		1	2	3	4	5	6	7	8	9	10
4 060	*B * ERRSTP	Λ	Λ	Λ	Λ	Λ	Λ				
		Λ	Λ	Λ	Λ	Λ	Λ				
4 070	*C 0007 WCCT	Λ	Λ	Λ	Λ	Λ	Λ				
		Λ	Λ	Λ	Λ	Λ	Λ				
4 080	*B * ERRSTP	Λ	Λ	Λ	Λ	Λ	Λ				
		Λ	Λ	Λ	Λ	Λ	Λ				
4 090	*MCW RECMRK 0046	Λ	Λ	Λ	Λ	Λ	Λ				
4 091	*MCW BLANK TEMP +133 1	Λ	Λ	Λ	Λ	Λ	Λ				
4 092	*MCW BLANK TEMP +129 1	Λ	Λ	Λ	Λ	Λ	Λ				
4 093	*MCW BLANK TEMP +128 1	Λ	Λ	Λ	Λ	Λ	Λ				
4 094	*MCW BLANK TEMP +125 1	Λ	Λ	Λ	Λ	Λ	Λ				
4 095	*MCW BLANK TEMP +122 1	Λ	Λ	Λ	Λ	Λ	Λ				
4 100	*MCM 0007 TEMP +082 1	Λ	Λ	Λ	Λ	Λ	Λ				
4 110	*MA CON52 0089	Λ	Λ	Λ	Λ	Λ	Λ				
		Λ	Λ	Λ	Λ	Λ	Λ				
4 120	*B * CONTH WCCT	Λ	Λ	Λ	Λ	Λ	Λ				
		Λ	Λ	Λ	Λ	Λ	Λ				
4 130	XX *B CONTI XX	Λ	Λ	Λ	Λ	Λ	Λ				
		Λ	Λ	Λ	Λ	Λ	Λ				
4 140	CONTH *C UPDATE +005 TEMP +005	Λ	Λ	Λ	Λ	Λ	Λ				
		Λ	Λ	Λ	Λ	Λ	Λ				
4 150	*B * CONTJ	Λ	Λ	Λ	Λ	Λ	Λ				
		Λ	Λ	Λ	Λ	Λ	Λ				
4 160	*C CONS2 -001 TEMP +055	Λ	Λ	Λ	Λ	Λ	Λ				
		Λ	Λ	Λ	Λ	Λ	Λ				
4 170	*B * CONTK	Λ	Λ	Λ	Λ	Λ	Λ				
		Λ	Λ	Λ	Λ	Λ	Λ				
4 171	*CU (U2	Λ	Λ	Λ	Λ	Λ	Λ				
		Λ	Λ	Λ	Λ	Λ	Λ				
4 180	WRTAPL *MJ (U2 TEMP +001	Λ	Λ	Λ	Λ	Λ	Λ				
		Λ	Λ	Λ	Λ	Λ	Λ				

					1	2	3	4	5	6	7	8	9	10
5 110		***** *MCW UPDATE +020 TEMP +095 1 *****			A	A	A	V	V	V	A	V		
		CONTO			A	A	A	V	V	V	A	V		
5 120	CONTO	*B * CONTP UPDATE +024 *****			A	A	A	V	V	V	A	V		
					A	A	A	V	V	V	A	V		
5 130		***** *MCW UPDATE +024 TEMP +099 1 *****			A	A	A	V	V	V	A	V		
		CONTP			A	A	A	V	V	V	A	V		
5 140	CONTP	*B * CONTPQ UPDATE +026 *****			A	A	A	V	V	V	A	V		
					A	A	A	V	V	V	A	V		
5 141		***** *C UPDATE +026 TEMP +101 1 *****			A	A	A	V	V	V	A	V		
					A	A	A	V	V	V	A	V		
5 142		*B * CONTPQ *****	S		A	A	A	V	V	V	A	V		
					A	A	A	V	V	V	A	V		
5 150		***** *C CON410 -002 TEMP +055 *****			A	A	A	V	V	V	A	V		
					A	A	A	V	V	V	A	V		
5 160		*B * CONTPQ *****	U		A	A	A	V	V	V	A	V		
					A	A	A	V	V	V	A	V		
5 170		***** *C UPDATE +026 CON2 *****			A	A	A	V	V	V	A	V		
					A	A	A	V	V	V	A	V		
5 180		*B * CONTR *****	U		A	A	A	V	V	V	A	V	V	
					A	A	A	V	V	V	A	V	V	
5 190		*B * CONTPQ TEMP +055 *****	4		A	A	A	V	V	V	A	V	V	
					A	A	A	V	V	V	A	V	V	
5 200		***** *MCW CON3 TEMP +055 *****			A	A	A	V	V	V	A	V	V	
		CONTS			A	A	A	V	V	V	A	V	V	
6 010	CONTS	***** *MCW ASTER TEMP +056 *****			A	A	A	V	V	V	A	V	V	A
					1	2	3	4	5	6	7	8	9	10

			1	2	3	4	5	6	7	8	9	10
5 190		*****	A	A	A	V	V	V	A	V	V	
6 200		*MCW ZERO TEMP +116 1 *	A	A	A	V	V	V	A	V	V	
		*****	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
7 010		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	A	A	A	V	V	V	A	V	V	
		*B CONTAJ	A	A	A	V	V	V	A	V	V	
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	A	A	A	V	V	V	A	V	V	
		CONTAJ 1-----	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
7 020	CONTAJ	*****	A	A	A	V	V	V	A	V	V	
7 030		*MA WORKP -0.1 TEMP +116 1 *	A	A	A	V	V	V	A	V	V	
7 040		*MCW WORKP -0.1 TEMP +116 1 *	A	A	A	V	V	V	A	V	V	
7 050		*ZA ZERO WORKD -0.2 *	A	A	A	V	V	V	A	V	V	
7 060		*MCW TEMP +116 1 WORKD -0.2 *	A	A	A	V	V	V	A	V	V	
7 070		*B WORKA -0.5 WORKD -0.5 *	A	A	A	V	V	V	A	V	V	
		*MCW WORKD -0.7 TEMP +116 1 *	A	A	A	V	V	V	A	V	V	
		*****	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
		CONTAJ 1-----	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
7 130	CONTAJ	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	A	A	A	V	V	V	A	V	V	
		*B REVISE	A	A	A	V	V	V	A	V	V	
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
7 140		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	A	A	A	V	V	V	A	V	V	
		*B CONTH	A	A	A	V	V	V	A	V	V	
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
		CONTH 1-----	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
7 150	CONTH	*****	A	A	A	V	V	V	A	V	V	
		*MCW ASTER TEMP +0.6 *	A	A	A	V	V	V	A	V	V	
		*****	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
7 160		*****	A	A	A	V	V	V	A	V	V	
		*B CONTX UPDATE +0.4 *	A	A	A	V	V	V	A	V	V	
		*****	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
7 190		*****	A	A	A	V	V	V	A	V	V	
		*MCW UPDATE +0.4 TEMP +0.4 *	A	A	A	V	V	V	A	V	V	
		*****	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
		CONTX 1-----	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
7 200	CONTX	*****	A	A	A	V	V	V	A	V	V	
		*B CONTX UPDATE +0.4 *	A	A	A	V	V	V	A	V	V	
		*****	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
8 030		*****	A	A	A	V	V	V	A	V	V	
		*MCW UPDATE +0.4 TEMP +0.4 *	A	A	A	V	V	V	A	V	V	
		*****	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
		CONTX 1-----	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
8 040	CONTX	*****	A	A	A	V	V	V	A	V	V	
		*B CONTX UPDATE +0.4 *	A	A	A	V	V	V	A	V	V	
		*****	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	
		1	A	A	A	V	V	V	A	V	V	

						1	2	3	4	5	6	7	8	9	10
8 070		*****		*****		A	A	A	V	V	V	A			
		*MCW UPDATE +051		TEMP +051	*	A	A	A	V	V	V	A			
		*****		*****		A	A	A	V	V	V	A			
		CONTIZ				A	A	A	V	V	V	A			
8 080	CONTIZ	*B		CONTAA	UPDATE +055	A	A	A	V	V	V	A			
		*****		*****		A	A	A	V	V	V	A			
						A	A	A	V	V	V	A			
						A	A	A	V	V	V	A			
						A	A	A	V	V	V	A			
8 110		*****		*****		A	A	A	V	V	V	A			
		*MCW UPDATE +055		TEMP +055	*	A	A	A	V	V	V	A			
		*****		*****		A	A	A	V	V	V	A			
		CONTAA				A	A	A	V	V	V	A			
8 120	CONTAA	*B		CONTAB	UPDATE +062	A	A	A	V	V	V	A			
		*****		*****		A	A	A	V	V	V	A			
						A	A	A	V	V	V	A			
						A	A	A	V	V	V	A			
						A	A	A	V	V	V	A			
8 150		*****		*****		A	A	A	V	V	V	A			
		*MCW UPDATE +062		TEMP +062	*	A	A	A	V	V	V	A			
		*****		*****		A	A	A	V	V	V	A			
		CONTAB				A	A	A	V	V	V	A			
8 160	CONTAB	*B		CONTAC	UPDATE +067	A	A	A	V	V	V	A			
		*****		*****		A	A	A	V	V	V	A			
						A	A	A	V	V	V	A			
						A	A	A	V	V	V	A			
						A	A	A	V	V	V	A			
8 190		*****		*****		A	A	A	V	V	V	A			
		*MCW UPDATE +067		TEMP +067	*	A	A	A	V	V	V	A			
		*****		*****		A	A	A	V	V	V	A			
		CONTAC				A	A	A	V	V	V	A			
8 200	CONTAC	*B		CONTAD	UPDATE +073	A	A	A	V	V	V	A			
		*****		*****		A	A	A	V	V	V	A			
						A	A	A	V	V	V	A			
						A	A	A	V	V	V	A			
						A	A	A	V	V	V	A			
9 030		*****		*****		A	A	A	V	V	V	A			
		*MCW UPDATE +073		TEMP +073	*	A	A	A	V	V	V	A			
		*****		*****		A	A	A	V	V	V	A			
		CONTAD				A	A	A	V	V	V	A			
9 040	CONTAD	*B		CONTAE	UPDATE +079	A	A	A	V	V	V	A			
		*****		*****		A	A	A	V	V	V	A			
						A	A	A	V	V	V	A			
						A	A	A	V	V	V	A			
						A	A	A	V	V	V	A			
9 070		*****		*****		A	A	A	V	V	V	A			
		*MCW UPDATE +079		TEMP +079	*	A	A	A	V	V	V	A			
		*****		*****		A	A	A	V	V	V	A			
		CONTAE				A	A	A	V	V	V	A			
9 080	CONTAE	*B		REVISE		A	A	A	V	V	V	A			
		X(XXXXX)XXXXXXXXXXXXX		XXXXXXXXXXXXXXXXXXXX		A	A	A	V	V	V	A			
		X(XXXXX)XXXXXXXXXXXXX		XXXXXXXXXXXXXXXXXXXX		A	A	A	V	V	V	A			

[illegible]

			1	2	3	4	5	6	7	8	9	10
13 030		*****	1	V	V	V		A	A			
13 031		*MCW TEMP +077 2 DAYS	1	V	V	V		A	A			
		*MCW ZERO -003 SLACK	1	V	V	V		A	A			
		*****	1	V	V	V		A	A			
		1	1	V	V	V		A	A			
		1	1	V	V	V		A	A			
13 032		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	1	V	V	V		A	A			
		*R CONTAS	1	V	V	V		A	A			
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	1	V	V	V		A	A			
		CONTGA 1	1	V	V	V		A	A			
13 033	CONTGA	*****	1	V	V	V		A	A			
13 034		*MCW TEMP +077 2 SLACK	1	V	V	V		A	A			
13 035		*S WORKA -006 SLACK	1	V	V	V		A	A			
13 036		*MN SLACK DAYS	1	V	V	V		A	A			
		*MCW DAYS SLACK	1	V	V	V		A	A			
		*****	1	V	V	V		A	A			
		1	1	V	V	V		A	A			
		1	1	V	V	V		A	A			
13 037		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	1	V	V	V		A	A			
		*B CONTAS	1	V	V	V		A	A			
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	1	V	V	V		A	A			
		CONTAT 1	1	V	V	V		A	A			
13 038	CONTAT	*****	1	V	V	V		A	A			
		*MCW ZERO -003 DAYS	1	V	V	V		A	A			
		*****	1	V	V	V		A	A			
		1	1	V	V	V		A	A			
		1	1	V	V	V		A	A			
13 040		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	1	V	V	V		A	A			
		*B CONTAS	1	V	V	V		A	A			
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	1	V	V	V		A	A			
		PAYCLC 1	1	V	V	V		A	A			
13 070	PAYCLC	*****	1	V	V	V		A	A			
13 080		*ZA ZERO WORKC -002	1	V	V	V		A	A			
13 090		*MCW CONSNT +002 WORKC -002	1	V	V	V		A	A			
13 100		*D TEMP +041 WORKC -004	1	V	V	V		A	A			
13 110		*A CON52 -001 WORKC -002	1	V	V	V		A	A			
13 120		*MCW WORKC -003 PAYOFF	1	V	V	V		A	A			
13 130		*ZA ZERO WORKC	1	V	V	V		A	A			
13 140		*MCW CONSNT +005 WORKC -002	1	V	V	V		A	A			
13 150		*D TEMP +055 WORKC -004	1	V	V	V		A	A			
13 160		*A CON52 -001 WORKC -002	1	V	V	V		A	A			
13 170		*A WORKC -003 PAYOFF	1	V	V	V		A	A			
13 180		*MCW TEMP +051 WORKC	1	V	V	V		A	A			
		*C 0404 TEMP +048	1	V	V	V		A	A			
		*****	1	V	V	V		A	A			
		1	1	V	V	V		A	A			
		1	1	V	V	V		A	A			
13 181		*B CONTAV	1	V	V	V		A	A			
		*****	1	V	V	V		A	A			
		1	1	V	V	V		A	A			
		1	1	V	V	V		A	A			
13 190		*****	1	V	V	V		A	A			
		*S CON635 WORKB	1	V	V	V		A	A			
		*****	1	V	V	V		A	A			
		CONTAV 1	1	V	V	V		A	A			
13 200	CONTAV	*****	1	V	V	V		A	A			
14 010		*S 0407 WORKB	1	V	V	V		A	A			
14 020		*ZA ZERO WORKA	1	V	V	V		A	A			
14 030		*MCW CONSNT +008 WORKA -002	1	V	V	V		A	A			
14 040		*J WORKB WORKA -004	1	V	V	V		A	A			
14 050		*A CON52 -001 WORKA -005	1	V	V	V		A	A			
14 060		*A WORKA -006 PAYOFF	1	V	V	V		A	A			
14 070		*MCW 0407 WORKB	1	V	V	V		A	A			
		*C 0404 TEMP +064	1	V	V	V		A	A			
		*****	1	V	V	V		A	A			

						1	2	3	4	5	6	7	8	9	10
14 080	*H	CONTAW			S				V						
						V			V						
						V			V						
14 090	*S	CON635	WORKB			V			V						
						V			V						
		CONTAW				V			V						
14 100	CONTAW	*S	TEMP +067	WORKB		V			V						
14 110		*MCW	CONSNT +011	WORKB -005		V			V						
14 120		*M	WORKB	WORKE		V			V						
14 130		*A	CONS2 -001	WORKE -002		V			V						
14 140		*A	WORKE -003	PAYOFF		V			V						
14 150		*MCW	ZERO	0029		V			V						
						V			V						
		SHIFT				V			V						
14 160	SHIFT	*MCW	00B9	0074		A			V						
						A			V						
						A			V						
14 161		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				A			V						
		*B	SETRK			A	V		V						
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				A	V		V						
		SHIFTA				A	V		V						
14 162	SHIFTA	*B	PACK	TABLE +010 1		A	V	A	V						
						A	V	A	V						
						A	V	A	V						
14 170		*C	TABLE +010 1	PAYOFF		A	V	A	V						
						A	V	A	V						
						A	V	A	V						
14 180		*B	CONTAX		U	A	V	A	V						
						A	V	A	V						
						A	V	A	V						
14 190		*MA	CON83	0089		A	V	A	V						
						A	V	A	V						
						A	V	A	V						
14 200		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				A	V	A	V						
		*B	SHIFT			V	A	V	V						
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				V	A	V	V						
		CONTAX				V	A	V	V						
15 010	CONTAX	*MCW	0089	0074		V	A	V	V						
						V	A	V	V						
		CONTAZ				V	A	V	V						
15 020	CONTAZ	*MA	CON83	0074		A	V	A	V						
						A	V	A	V						

			1	2	3	4	5	6	7	8	9	10
15 030	*B	CONTAY	TABLE	+010 2								
15 040	*B	CONTAZ										
15 050	CONTAY											
15 051												
15 060	SETMRK											
15 070												
15 080												
15 090												
15 100	CONTBA											
15 110												
15 120												
15 130												
15 140	*B	SHIFTA	WCCT									
15 150	*B	CONTRA										
15 160	PACK											
15 170												
15 180												
15 181												
15 190												
15 200												
16 010												
16 020	CONTRB											
16 030												
16 031	*B	CONTRD	TEMP	+064 3								
16 032	*C	TEMP	+064 3	ZERO								

Line	Label	Code	Text	1	2	3	4	5	6	7	8	9	10
16 100	CONTRP		*****										
16 101			*MCW ZERO 0099										
			*MCW ZERO COUNT2										

			1										
			CONTRK										

16 110	CONTRK		*MCW ZERO 0094										
16 120			*MCW ZERO 0099										
16 130			*MCW ZERO HCOUNT										
16 131			*MCW ZERO REPEAT										
16 132			*MCW ZERO WCLT										
16 133			*MCW 0099 WAIT										
16 140			*MCW CON01 FUND										
16 150			*C COUNT1 COUNT2										

			1										
			1										
			1										

16 160		*B	CONTRC										

			1										
			1										
			1										
16 170		*A	CON01 LIMIND										

			1										
			1										
			1										
16 180		*B	CONTRP LIMIND										

			1										
			1										
			1										
16 190		*B	PRINT										
			XX										
			XX										

			CONTRC										

16 200	CONTRC	*A	CON01 COUNT2										

			1										
			CONTRH										

17 010	CONTRH	*C	FUND TABLE +006 3										

			1	2	3	4	5	6	7	8	9	10
17 070	*C	FNDMAX +004 2 FNDREG +004 2	V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
17 080	*P	CONTRJ	V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
17 081	*B	CONTRN	V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
17 090	*MA	CON83 0099	V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
17 100	*B	CONTRK	V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
17 110	*C	FNDREG +004 2 FNDMIN +004 2	V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
17 120	*B	CONTRN	V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
17 130	*C	WC MAX +004 1 WCREG +004 1	V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
17 140	*P	CONTRM	V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
17 150	*MA	CON9 0099	V	A	V	A	V	A	V	A	V	A
17 170	*MA	CON4 0089	V	A	V	A	V	A	V	A	V	A
17 180	*A	CON31 WCCT	V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
17 190	*B	CONTRM WCCT	V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A
			V	A	V	A	V	A	V	A	V	A

		1	2	3	4	5	6	7	8	9	10
17 200	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *B CONTBG XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	V	V	A	A		V	A			
	CONTPN 1	V	V	A	A		V	A			
18 010	***** *MCW WAIT 0099 * *MCW ZERO 0089 * *MCW ZERO WCOL * *****	V	V	A	A		V	A			
18 020		V	V	A	A		V	A			
18 030		V	V	A	A		V	A			
	*****	V	V	A	A		V	A			
18 040	*B * CONTROL REPEAT * 0 * *****	V	V	A	A		V	A			
	*****	V	V	A	A		V	A			
18 041	***** *MCW ASTER TABLE +083 3 * *MCW ZERO REPEAT * *****	V	V	A	A		V	A			
18 050		V	V	A	A		V	A			
	*****	V	V	A	A		V	A			
18 060	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *B CONTBG XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	V	V	A	A		V	A			
	CONTPN 1	V	V	A	A		V	A			
18 070	***** *B * CONTBG TABLE +013 3 * *****	V	V	A	A		V	A			
	*****	V	V	A	A		V	A			
18 080	***** *C TABLE +013 3 TABLE +019 3 * *****	V	V	A	A		V	A			
18 090	*****	V	V	A	A		V	A			
18 090	*B * CONTBG * S * *****	V	V	A	A		V	A			
	*****	V	V	A	A		V	A			
18 100	***** *C HCOUNT TABLE +016 3 * *****	V	V	A	A		V	A			
	*****	V	V	A	A		V	A			
18 110	*B * CONTBG * U * *****	V	V	A	A		V	A			
	*****	V	V	A	A		V	A			
18 160	***** *A CON01 TABLE +019 3 * *A CON01 ENDREG +004 2 * *A CON01 WCREG +004 1 * *A TABLE +010 3 WORKC * *MCW CON01 REPEAT * *A CON01 HCOUNT * *****	V	V	A	A		V	A			
18 170		V	V	A	A		V	A			
18 180		V	V	A	A		V	A			
18 200		V	V	A	A		V	A			
19 010		V	V	A	A		V	A			
19 011	*****	V	V	A	A		V	A			
19 020	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *B CONTBG XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	V	V	A	A		V	A			

		PRINT	1	2	3	4	5	6	7	8	9	10
19 030	PRINT	*****	A									
19 031		*CC	A									
19 032		*MCW DATE 0272	A									
19 033		*MCW HEAD1	A									
19 034		*MCW HEAD3 0313	A									
19 060		*****	A									
		1	A									
		1	A									
19 061	*B	*****	A	V								
		*C	A	V								
		*****	A	V								
		1	A	V								
		1	A	V								
19 062		*****	A	V								
		*MCW TENT 0215	A	V								
		*****	A	V								
		1	A	V								
		CONTDZ	A									
19 070	CONTDZ	*****	A									
19 080		*MCS PAGECT 0315	A									
19 090		*CC	A									
19 100		*W	A									
19 110		*CS 0332	A									
19 120		*CS	A									
19 130		*MCW HEAD4 0252	A									
19 140		*CC	A									
19 150		*W	A									
19 160		*CS 0299	A									
19 170		*MCW HEAD2 0290	A									
19 180		*CC	A									
19 190		*W	A									
19 200		*CS 0299	A									
19 201		*****	A									
		1	A									
		CONTPX	A	A								
20 030	CONTPX	*****	A	A								
20 040		*MCW ZERO 0009	A	A								
20 050		*MCW ZERO 0094	A	A								
20 060		*MCW ZERO 0099	A	A								
		*MCW ZERO COUNT2	A	A								
		*****	A	A								
		1	A	A								
		1	A	A								
20 070	*B	*****	A	A	V							
		*K	A	A	V							
		*****	A	A	V							
		1	A	A	V							
		CONTPS	A	A	V							
20 080	CONTPS	*****	A	A	V	A						
		*MU (U2 TEMP +001 R	A	A	V	A						
		*****	A	A	V	A						
		1	A	A	V	A						
		1	A	A	V	A						
20 090	*B	*****	A	A	V	A						
		*L	A	A	V	A						
		*****	A	A	V	A						
		1	A	A	V	A						
		1	A	A	V	A						
20 100	CONTPB	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	A	A	V	A	V					
		*****	A	A	V	A	V					
		1	A	A	V	A	V					
		1	A	A	V	A	V					
		CONTPQ	A	A	V	A	V					
20 110	CONTPQ	*****	A	A	V	A	V					
		*CU (U2 R	A	A	V	A	V					
		*****	A	A	V	A	V					
		1	A	A	V	A	V					
		1	A	A	V	A	V					
20 120	CONTHS	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	A	A	V	A	V					
		*****	A	A	V	A	V					

					1	2	3	4	5	6	7	8	9	10
		CONTR	}		A	A	V			A				
20 130	CONTR	*C	TEMP +005	TABLE +005 1	A	A	V			A				
		*		*	A	A	V			A				
		*		*	A	A	V			A				
		*		*	A	A	V			A				
		*		*	A	A	V			A				
		*		*	A	A	V			A				
20 140		*B	CONTR	S	A	A	V	V		A				
		*		*	A	A	V	V		A				
		*		*	A	A	V	V		A				
		*		*	A	A	V	V		A				
		*		*	A	A	V	V		A				
20 150		*MA	CON83	0089	A	A	V	V		A				
20 160		*A	CON01	COUNT2	A	A	V	V		A				
20 170		*C	COUNT1	COUNT2	A	A	V	V		A				
		*		*	A	A	V	V		A				
		*		*	A	A	V	V		A				
		*		*	A	A	V	V		A				
20 180		*B	CONTR	T	A	A	V	V		A				
		*		*	A	A	V	V		A				
		*		*	A	A	V	V		A				
			CONTRW		A	A	V	V		A				
		*		*	A	A	V	V		A				
20 190	CONTRW	*B	CONTRFB	B	A	A	V	V		A	V			
		*		*	A	A	V	V		A	V			
		*		*	A	A	V	V		A	V			
		*		*	A	A	V	V		A	V			
20 191		*B	CONTRX		A	A	V	V		A	V			
		*		*	A	A	V	V		A	V			
		*		*	A	A	V	V		A	V			
		*		*	A	A	V	V		A	V			
			CONTRFB		A	A	V	V		A	V			
20 200	CONTRFB	*MCW	ZERO	WCCT	A	A	V	V		A				
		*		*	A	A	V	V		A				
		*		*	A	A	V	V		A				
		*		*	A	A	V	V		A				
		*		*	A	A	V	V		A				
21 010		*B	CONTRBU	TEMP +006	A	A	V	V		A	V			
		*		*	A	A	V	V		A	V			
		*		*	A	A	V	V		A	V			
		*		*	A	A	V	V		A	V			
		*		*	A	A	V	V		A	V			
21 020		*MCM	TEMP +001	0101	A	A	V	V		A	V			
21 021		*MCW	BLANK -003	0106	A	A	V	V		A	V			
21 030		*P			A	A	V	V		A	V			
21 031		*CS	0180		A	A	V	V		A	V			
		*		*	A	A	V	V		A	V			
		*		*	A	A	V	V		A	V			
			CONTRBU		A	A	V	V		A	V			
		*		*	A	A	V	V		A	V			
21 040	CONTRBU	*B	CONTRDR	TEMP +003 2	A	A	V	V		A	V			
		*		*	A	A	V	V		A	V			
		*		*	A	A	V	V		A	V			
		*		*	A	A	V	V		A	V			
		*		*	A	A	V	V		A	V			
21 041		*MCM	TEMP +002 2	0107	A	A	V	V		A	V			
21 050		*MCW	TEMP +005	0105	A	A	V	V		A	V			
21 060		*MCW	BLANK -003	0146	A	A	V	V		A	V			
21 061		*MCW	BLANK -003	0108	A	A	V	V		A	V			
21 070		*P			A	A	V	V		A	V			
		*		*	A	A	V	V		A	V			

						1	2	3	4	5	6	7	8	9	10
		CONDR													
21 080	CONDR	*MA	CON52	0094		A	A	V	V	A	A				
21 090		*A	CON01	WCCT		A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
21 100		*B	CONTRx	WCCT	8	A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
21 110		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				A	A	V	V	A	A				
		*B	CONTRU			A	A	V	V	A	A				
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
21 120	CONTRU	*B	CONTRV	TABLE +083 1		A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
21 121		*B	CONTRW	TEMP +055 1		A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
21 130		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				A	A	V	V	A	A				
		*B	CONTRW			A	A	V	V	A	A				
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
21 131	CONTRW	*MCW	CON2	TEMP +055		A	A	V	V	A	A				
21 131		*MCW	ASTER	TEMP +006		A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
21 132		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				A	A	V	V	A	A				
		*B	CONTRW			A	A	V	V	A	A				
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
21 140	CONTRV	*B	CONTRC		B	A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
21 141		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				A	A	V	V	A	A				
		*B	CONTRZ			A	A	V	V	A	A				
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
21 150	CONTRC	*MCW	ZERO	WCCT		A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				
21 151		*B	CONTRD	TEMP +006		A	A	V	V	A	A				
						A	A	V	V	A	A				
						A	A	V	V	A	A				

[illegible]

				1	2	3	4	5	6	
22 143	*R	CONTCA	TEMP +083 2	-----		A	A	V	A	V
				A	A	V	A	V	V	
				A	A	V	A	V	V	
				A	A	V	A	V	V	
				A	A	V	A	V	V	
				A	A	V	A	V	V	
22 144	*P			A	A	V	A	V	V	
				A	A	V	A	V	V	
				A	A	V	A	V	V	
		CONTCA		A	A	V	A	V	V	
				A	A	V	A	V	V	
22 144	*B	CONTCU	TABLE +019 3	-----		A	A	V	A	V
				A	A	V	A	V	V	
				A	A	V	A	V	V	
				A	A	V	A	V	V	
				A	A	V	A	V	V	
				A	A	V	A	V	V	
22 145	*MCW	TABLE +019 3	0150	A	A	V	A	V	V	
22 145	*MCW	ZERO -003	0147	A	A	V	A	V	V	
22 146	*MCW	DATE	0173	A	A	V	A	V	V	
22 147	*P			A	A	V	A	V	V	
22 148	*SS			A	A	V	A	V	V	
22 149	*CS	C180		A	A	V	A	V	V	
				A	A	V	A	V	V	
		CONTCU		A	A	V	A	V	V	
				A	A	V	A	V	V	
22 150	*MA	CON52	0094	A	A	V	A	V	V	
22 160	*MA	CON9	0099	A	A	V	A	V	V	
22 170	*A	CON01	WCCT	A	A	V	A	V	V	
				A	A	V	A	V	V	
				A	A	V	A	V	V	
				A	A	V	A	V	V	
				A	A	V	A	V	V	
22 180	*B	CONTBZ	WCCT 8	-----		A	A	V	A	V
				A	A	V	A	V	V	
				A	A	V	A	V	V	
				A	A	V	A	V	V	
				A	A	V	A	V	V	
				A	A	V	A	V	V	
22 190	*B	CONTC		-----		A	A	V	A	V
				A	A	V	A	V	V	
				A	A	V	A	V	V	
				A	A	V	A	V	V	
		CONTBZ		A	A	V	A	V	V	
				A	A	V	A	V	V	
22 200	*MCS	TABLE +005 1	0205	A	A	V	A	V	V	
22 210	*MCW	TABLE +006 1	0210	A	A	V	A	V	V	
22 220	*MCS	TABLE +010 1	0218	A	A	V	A	V	V	
22 230	*MCW	0089	0094	A	A	V	A	V	V	
22 240	*MCW	ZERO	0099	A	A	V	A	V	V	
22 241	*MCW	ZERO	WCCT	A	A	V	A	V	V	
				A	A	V	A	V	V	
		CONTCN		A	A	V	A	V	V	
				A	A	V	A	V	V	
22 250	*B	CONTC	TABLE +019 2	-----		A	A	V	A	V
				A	A	V	A	V	V	
				A	A	V	A	V	V	
				A	A	V	A	V	V	
				A	A	V	A	V	V	
				A	A	V	A	V	V	
22 260	*B	CONTC	TABLE +019 2	-----		A	A	V	A	V
				A	A	V	A	V	V	
				A	A	V	A	V	V	
				A	A	V	A	V	V	
				A	A	V	A	V	V	
				A	A	V	A	V	V	

			1	2	3	4	5	6	7	8	9	10
23 010		***** *PCS TABLE + 19 2 02 6 3 *****	A	A	V	A	V					
		CONTROL	A	A	V	A	V					
23 020	CONTC	*A CON1 WCT	A	A	V	A	V	A				
23 030		*MA CON2 0174	A	A	V	A	V	A				
23 040		*MA CON3 0100	A	A	V	A	V	A				
		*****	A	A	V	A	V	A				
		*****	A	A	V	A	V	A				
		*****	A	A	V	A	V	A				
23 041		*C CONTCM WCT	A	A	V	A	V	A				
		*****	A	A	V	A	V	A				
		*****	A	A	V	A	V	A				
		*****	A	A	V	A	V	A				
23 042		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *L CONTCM XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	A	A	V	A	V	A				
		*****	A	A	V	A	V	A				
		*****	A	A	V	A	V	A				
		*****	A	A	V	A	V	A				
23 043	CONICL	***** *PCW TABLE + 019 2 02 6 3 *****	A	A	V							
		*****	A	A	V							
		*****	A	A	V							
		*****	A	A	V							
23 044		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *P CONTCM XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	A	A	V							
		*****	A	A	V							
		*****	A	A	V							
		*****	A	A	V							
23 050	CONTCM	*CC *****	A	A	V							
23 060		*W *****	A	A	V							
23 070		*CS 0299	A	A	V							
23 080		*A CON4 LINECT	A	A	V							
23 090		*C CONTR LINECT	A	A	V							
		*****	A	A	V							
		*****	A	A	V							
		*****	A	A	V							
23 100		*B CONTCM	A	A	V							
		*****	A	A	V							
		*****	A	A	V							
		*****	A	A	V							
23 110		*****	A	A	V							
23 111		*A CON1 PASECT	A	A	V							
		*PCW ZERO LINECT	A	A	V							
		*****	A	A	V							
		*****	A	A	V							
23 120		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *B PRINT XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	A	A	V							
		*****	A	A	V							
		*****	A	A	V							
		*****	A	A	V							
23 130	CONTR	*CC *****	A	A	V							
23 140		*PCW FOOT4 02 6	A	A	V							
23 150		*PCW ZERO WCT	A	A	V							
23 160		*PCW ZERO 0174	A	A	V							
23 170		*PCW ZERO 0100	A	A	V							
		*****	A	A	V							
		*****	A	A	V							
23 180	CONTR	***** *CS WCT + 4 2 6 *C WCT + 4 2 6 *****	A	A	V							
23 190		*****	A	A	V							

[illegible]

				1	2	3	4	5	6	7	8	9	10
25 061		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX											
		*B CONTDY											
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX											
		CONTCG											
25 070	CONTCG	*****											
25 071		*MCW ASTER 0217 2											
		*MCW ASTER NOTIND											

25 080		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX											
		*B CONTCI											
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX											
		CONTCJ											
25 081	CONTCJ	*****											
25 090		*MCW FOOT4 0210											
25 100		*CC											
25 110		*W 0299											

25 120		*B * CONTCJ NOTIND											
		* * *****											
		CONTCJ											
25 130	CONTCJ	*****											
25 140		*CC											
25 150		*MCW JOBEND 0214											
25 160		*W											
25 170		*CC											
		*H											

		CONTCJ											
25 180	CONTCJ	*****											
25 200		*MCW NOTE 0265											
25 210		*W											
		*CS 0299											

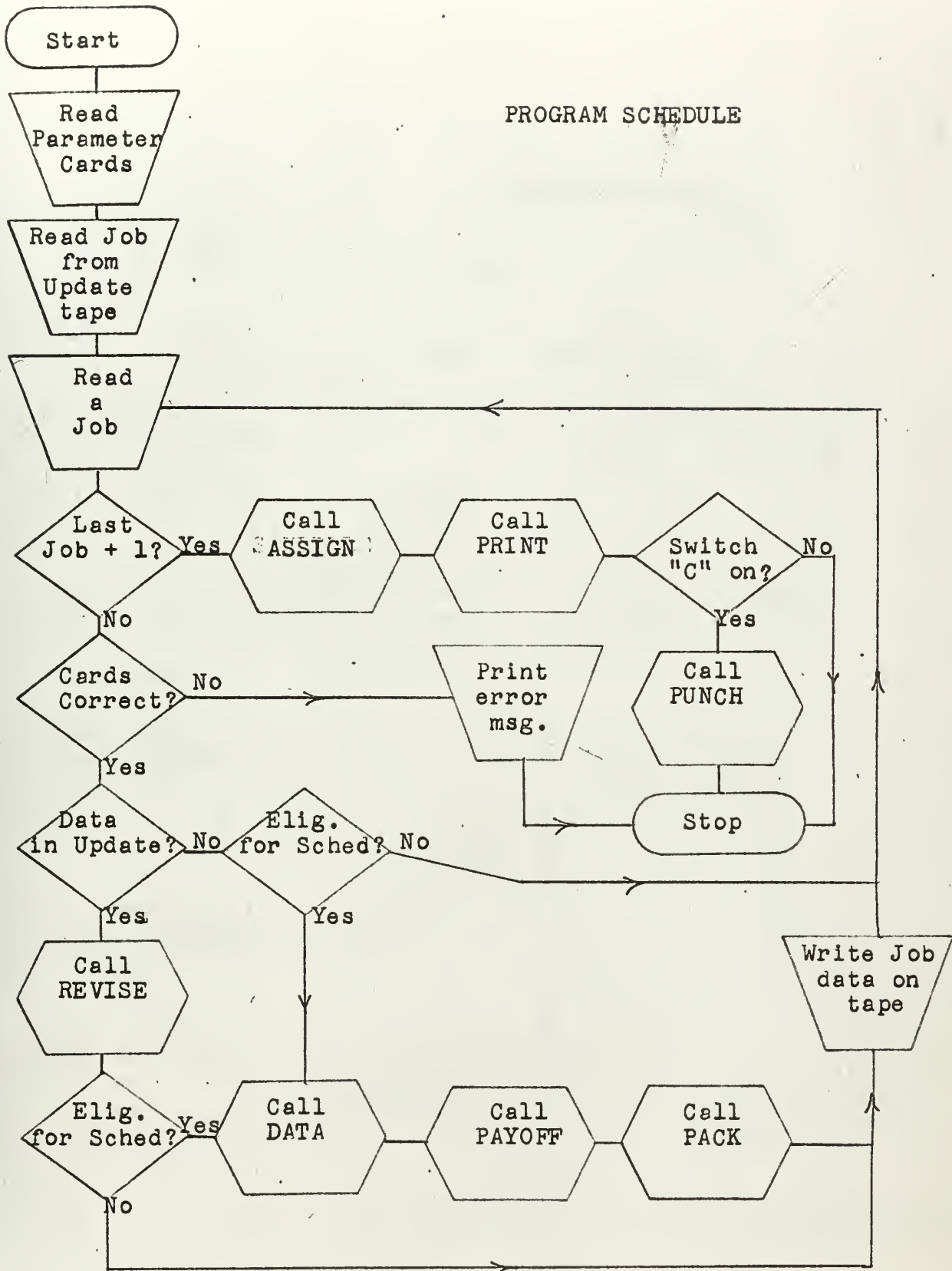
25 220		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX											
		*B CONTCJ											
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX											

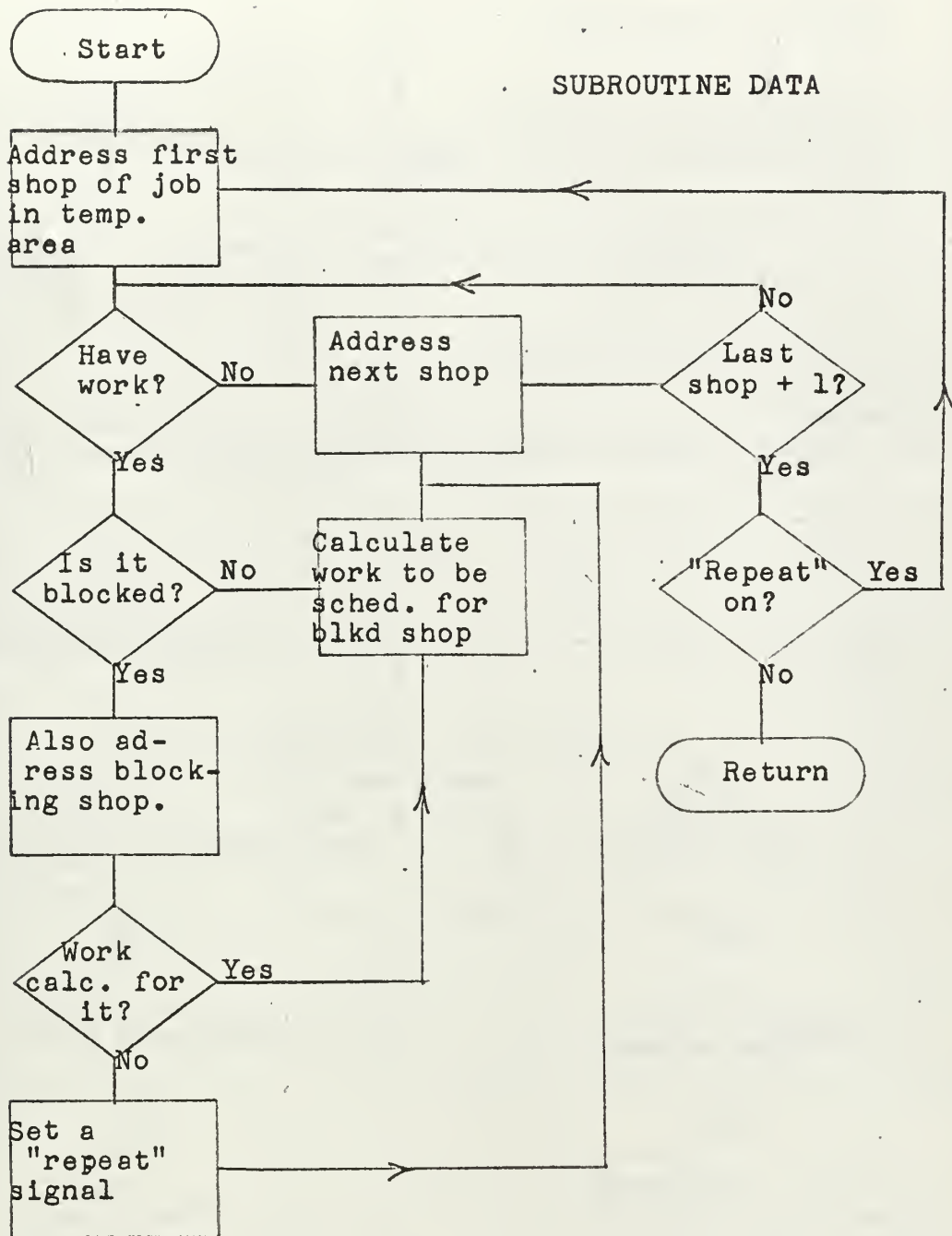
26 010	ZERO	DCW *	0000
26 020	CON15	DCW *	150
26 030	ERNOT1	DCW *	A READ-IN ERROR HAS OCCURRED.
26 040		DCW *	AFTER CORRECTION OF THE ERROR, T
26 050		DC *	HE PROGRAM CAN BE RESTARTED WITH
26 060		DC *	THE BEGINNING OF THE JOB WHICH
26 070	ERNOT2	DC *	SHOWED THE ERROR
26 080		DCW *	PLACE IN READ HOPPER, MASTER CAR
26 090	ERNOT3	DC *	D FIRST, AND PRESS START.
26 100	CON6	DCW *	6
26 110	WCCT	DCW 033	0
26 120	CON410	DCW *	410
26 130	RECMRK	DCW *	†
26 140	CON52	DCW *	052
26 150	GRPMRK	DCW 0691	

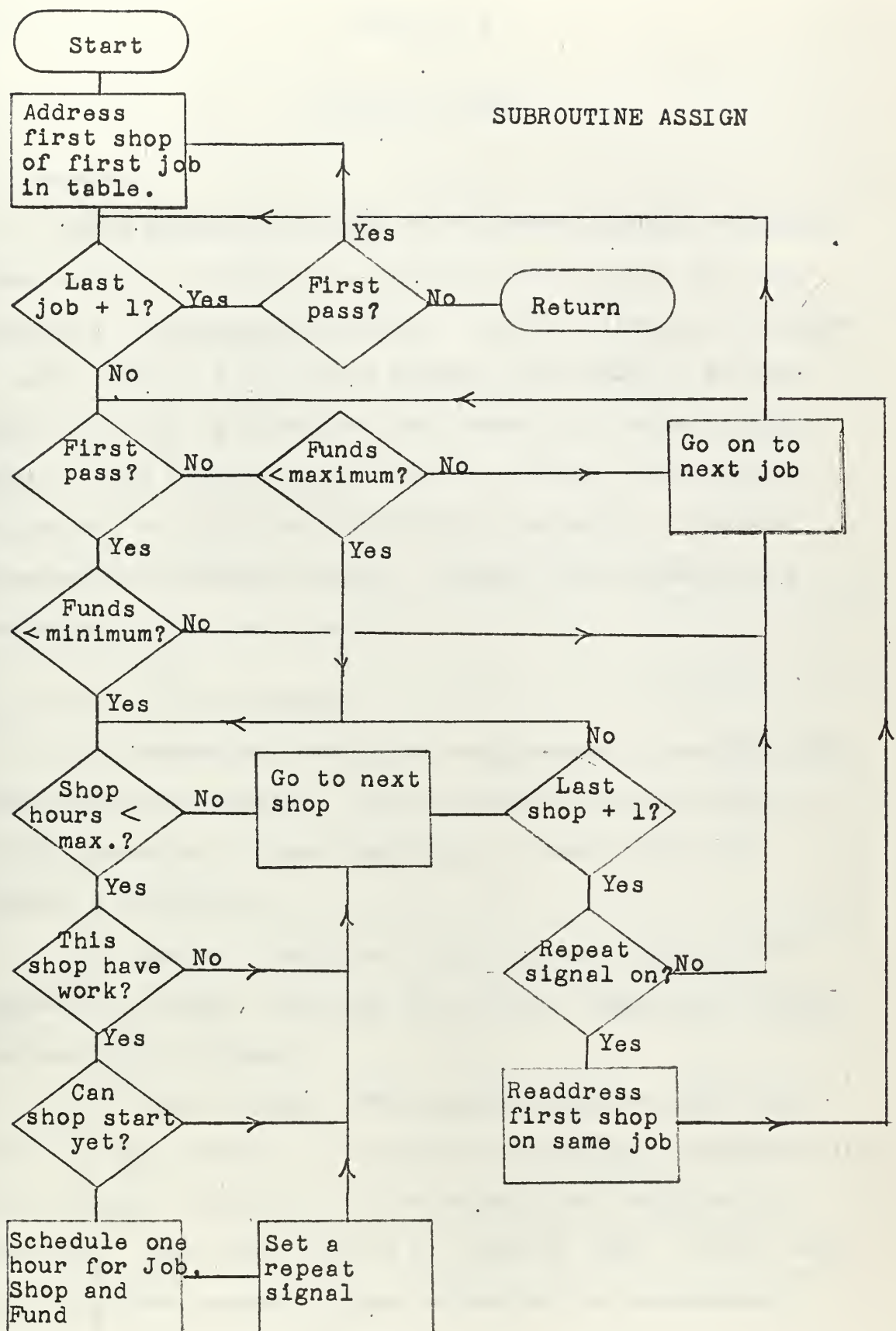
26 160	CON2	DCW *	2
26 170	ASTER	DCW *	*
26 180	REPEAT	DCW 0334	0
26 190	CUN9	DCW *	009
26 200	CON01	DCW *	0001
27 010	WURKA	DCW 0344	0000000000
27 020	WORKB	DCW 0348	0000
27 030	WORKC	DCW 0355	0000000
27 040	WORKD	DCW 0367	000000000000
27 050	SLACK	DCW 0376	0
27 060	DAYS	DCW 0377	0
27 070	ENTRY	DCW 0381	0000
27 080	WORKE	DCW 0375	00000000
27 090	PAYOFF	DCW 0385	0000
27 100	CONSNT	DS 0431	
27 110	CON635	DCW *	0635
27 120	CONR3	DCW *	083
27 130	BLANK	DCW *	
27 140	LIMIND	DCW 0386	0
27 150	FNDMIN	DS 0442	
27 160	FNDMAX	DS 0474	
27 170	FNDREG	DS 0538	
27 180	WCMAX	DS 0506	
27 190	WCREG	DS 0570	
27 200	COUNT1	DCW 0389	000
27 210	DASHES	DCW *	--
27 220	CON78	DCW *	78
27 230	NOTIND	DCW 0397	0
27 240	DATE	DS 0425	
27 250	UPDATE	DS 0610	
27 260	TEMP	DS 0700	
28 010	COUNT2	DCW 0392	000
28 020	HCDUNT	DCW 0396	0000
28 030	FUND	DCW 0398	0
28 040	FIN	DCW *	FIN
28 050	CON4	DCW *	004
28 060	WAIT	DCW 0605	000
28 070	CON8	DCW *	008
28 080	CON3	DCW *	3
28 081	TENT	DCW *	TENTATIVE
28 090		DCW *	SHOP WORK SCHEDULE FOR THE WEEK
28 100	HEAD1	DC *	ENDING
28 110	HEAD3	DCW *	PAGE NO.
28 120	HEAD4	DCW *	UNITS = MANHOURS
28 130		DCW *	JOB FUND PAYOFF SHOP 1 SHO
28 140		DC *	P 2 SHOP 3 SHOP 4 SHOP 5
28 150	HEAD2	DC *	SHOP 6 SHOP 7 SHOP 8
28 160		DCW *	FUND SOURCES 1 2
28 170		DC *	3 4 5 6
28 180	FOOT1	DC *	7 8

28 190	FOOT4	DCW *	MANHOUR TOTALS =
28 200		DCW *	* = INSUFFICIENT ACTIVATED WORK
28 210	NOTE	DC *	TO MEET SPECIFIED REQUIREMENTS
28 220	LINECT	DCW 0607	00
28 230	PAGECT	DCW 0609	01
28 240	JOBEND	DCW *	JOB COMPLETED
28 250	TABLE	DS 5500	
28 260		*END	START

PROGRAM SCHEDULE







APPENDIX B

PROGRAM REPORT

I. General

This program, written in the SPS language, prepares three printed reports of maintenance work under the cognizance of the Autosked system. The Job Listing is printed as data cards are processed through the reader. At the same time data is extracted and stored in a core storage table. Upon completion of the Job Listing, this data is called out to print the Work Backlog reports. A general discussion of program inputs, outputs, and operation is contained in the basic text.

II. Machine Requirements

A. Hardware. The basic requirement is an IBM 1401 data processing system. The processing unit must have a 16,000 character storage capacity. A read-punch and printer are required.

B. Special features. In addition to the 16,000 character storage, the high, low, equal compare and indexing features are used.

C. Core storage. The program requires 3295 positions of core storage. In addition, each job considered in the backlog is entered in core storage and requires 50 positions. The table starts at position 4000. Thus, 240 is the maximum number of jobs which can be accommodated.

III. Processing

A condensed program deck precedes the Library Deck in the read hopper. Stops occur if cards are detected out of sequence and a message giving the source of the error is printed. Completion of the job is signaled by a printed message.

IV. Card Deck Preparation

The Library Deck is processed as maintained. A Date Card, punched as follows, must precede the Library Deck:

Card Columns	Description
1	The letter "D" to identify the card as a Date Card
2-18	The calendar date the report is prepared (e.g., 18 May 1965)

A blank card is required behind the Library Deck to signal the end of the data.

V. Block Diagram

The block diagram which follows depicts the program logic and also serves as a SPS program listing. The glossary preceding the diagram identifies the labels used. A flow chart of general program logic follows the block diagram.

Label	Definition
ACON_	Constant used for address modification
ACTIND	Signal to indicate which backlog report is being prepared

Label	Definition
ASTER	An asterisk
COLHD_	Alphanumeric column headings for Job Listing
CON___	Numeric constant
CONHDG	Job Listing heading
CONT__	Jump in the program
DASH(ES)	Dash(es) used in print-out and as a signal
DATE	The calendar date
EMPTY	Field of 4 blanks
ERCRD_	Error messages
ERRSTP	The error stop routine
FLAGCT	Counter of the number of activated jobs
FNDCOD	A sorter counter for fund sources
ITMHDG	A header for Job Listing
JOBEND	"Job Completed" message
LINECT	Count of lines used on a page
NEWJOB	Beginning of processing for each job
NEWPG1	Start new page of Job Listing
NEWPG2	Start new page of Backlog Report
PAGECT	Page counter
PAGEHDG	Heading for page number
PRNT	Beginning of routine to print a line of Job Listing
PRNTCT	Counter of the number of jobs listed
REPFT_	Alphanumeric footings for Backlog Reports
REPHD_	Alphanumeric headings for Backlog Reports

Label	Definition
STAT__	Alphanumeric description of job status
STORE_	Active/inactive identification routines
WCCT	Work center sorting counter
XFLGCT	Count of "not activated" jobs
ZEROCT	Field of 3 zeros

			1	2	3	4
2 070		*****	A	A	V	V
2 071		*MCW ERCD3 C266 *	A	A	V	V
		*MCW ERCD1 0250 *	A	A	V	V
		*****	A	A	V	V
		ERRSTP	A	A	V	V
2 072	ERRSTP	*****	A	A	V	V
2 073		*CC L*	A	A	V	V
2 074		*W	A	A	V	V
2 075		*CC 1*	A	A	V	V
		*CS C299 *	A	A	V	V
		*****	A	A	V	V
2 076		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	A	A	V	V
		*H NEWJOB *	A	A	V	V
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	A	A	V	V
		CCNT2	A	A	V	V
2 080	CONT2	*****	A	A	V	V
2 090		*SW 0001 *	A	A	V	V
2 100		*LCA 008C 048C *	A	A	V	V
2 110		*SW 0407 04C9 *	A	A	V	V
2 120		*SW 0412 0414 *	A	A	V	V
2 130		*SW 0419 0441 *	A	A	V	V
2 140		*SW 0455 0457 *	A	A	V	V
2 150		*SW 0458 0469 *	A	A	V	V
2 160		*SW 0475 *	A	A	V	V
2 170		*CS 0080 *	A	A	V	V
2 180		*MCS 0405 02C5 *	A	A	V	V
2 190		*MCW ITMHDG 0228 *	A	A	V	V
		*R	A	A	V	V
		SS 1	A	A	V	V
		*C 0005 04C5 *	A	A	V	V
		*****	A	A	V	V
2 200		*B CCNT18 *	A	A	V	V
		*****	A	A	V	V
3 010		*B CCNT3 0007 *	A	A	V	V
		*****	A	A	V	V
3 020	CONT18	*****	A	A	V	V
3 021		*MCW ERCD5 0268 *	A	A	V	V
		*MCW ERCD1 025C *	A	A	V	V
		*****	A	A	V	V
3 022		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	A	A	V	V
		*B ERRSTP *	A	A	V	V
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	A	A	V	V
		CCNT3	A	A	V	V
3 030	CONT3	*****	A	A	V	V
3 040		*SW 0001 00C9 *	A	A	V	V
3 050		*MCW 0080 03C1 *	A	A	V	V
3 060		*MCW 0423 C221 *	A	A	V	V
3 070		*CC S*	A	A	V	V
3 080		*W	A	A	V	V
3 090		*CS 0332 *	A	A	V	V
3 100		*MCW 0408 0210 *	A	A	V	V
3 110		*MCS 0411 0215 *	A	A	V	V
3 120		*MCW DASH 0216 *	A	A	V	V
3 130		*MCW 0413 0218 *	A	A	V	V
3 140		*MCW 0417 0224 *	A	A	V	V
3 150		*MCW 0441 0225 *	A	A	V	V
3 160		*MCW 0457 0237 *	A	A	V	V
3 170		*MCW 0462 0244 *	A	A	V	V
3 171		*MCW 0473 0251 *	A	A	V	V
		*MCW 0475 0257 *	A	A	V	V
		*****	A	A	V	V

			STORE2		A	A	V	A	A	V	V	V	V	V	V	V	V	A
4 090	STORE2	*****	*****	*****	A	A	V	A	A	V	V	V	V	V	V	V	V	A
4 091		*LCA 0405	40CC +CC5 1	*	1	2	3	4	5	6	7	8	9	10	11	12	13	14
4 100		*LCA 0457	40CC +007 1	*	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		*MA ACON50	C089	*	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		*****	*****	*****	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			A	A	V	A	A	V	V	V	V	V	V	V	V	A
4 101		*B PRNT		*	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			A	A	V	A	A	V	V	V	V	V	V	V	V	A
		*****	*****	*****	A	A	V	A	A	V	V	V	V	V	V	V	V	A
4 110	CONT5	*MCW STAT2	0298	*	A	A	V	A	A	V	V	V	V	V	V	V	V	A
4 120		*MCW STAT2A	0320	*	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		*****	*****	*****	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			A	A	V	A	A	V	V	V	V	V	V	V	V	A
4 130		*B STORE1		*	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			A	A	V	A	A	V	V	V	V	V	V	V	V	A
		*****	*****	*****	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			A	A	V	A	A	V	V	V	V	V	V	V	V	A
		*****	*****	*****	A	A	V	A	A	V	V	V	V	V	V	V	V	A
4 140	CONT6	*MCW STAT3	0295	*	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		*****	*****	*****	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			A	A	V	A	A	V	V	V	V	V	V	V	V	A
4 150		*B STORE1		*	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			A	A	V	A	A	V	V	V	V	V	V	V	V	A
		*****	*****	*****	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			A	A	V	A	A	V	V	V	V	V	V	V	V	A
		*****	*****	*****	A	A	V	A	A	V	V	V	V	V	V	V	V	A
4 151	CONT15	*MCW STAT4	0294	*	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		*****	*****	*****	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			A	A	V	A	A	V	V	V	V	V	V	V	V	A
4 152		*B STORE1		*	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			A	A	V	A	A	V	V	V	V	V	V	V	V	A
		*****	*****	*****	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			A	A	V	A	A	V	V	V	V	V	V	V	V	A
		*****	*****	*****	A	A	V	A	A	V	V	V	V	V	V	V	V	A
4 160	CONT7	*MCW STAT5	0298	*	A	A	V	A	A	V	V	V	V	V	V	V	V	A
4 170		*MCW STAT5A	0305	*	A	A	V	A	A	V	V	V	V	V	V	V	V	A
4 171		*A CON1	XFLGCT	*	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		*****	*****	*****	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			A	A	V	A	A	V	V	V	V	V	V	V	V	A
4 180		*B STORE2		*	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			A	A	V	A	A	V	V	V	V	V	V	V	V	A
		*****	*****	*****	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			A	A	V	A	A	V	V	V	V	V	V	V	V	A
		*****	*****	*****	A	A	V	A	A	V	V	V	V	V	V	V	V	A
4 190	CONT8	*MCW STAT6	0298	*	A	A	V	A	A	V	V	V	V	V	V	V	V	A
4 200		*MCW STAT6A	0302	*	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		*****	*****	*****	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			A	A	V	A	A	V	V	V	V	V	V	V	V	A
5 010		*B PRNT		*	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			A	A	V	A	A	V	V	V	V	V	V	V	V	A
		*****	*****	*****	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			A	A	V	A	A	V	V	V	V	V	V	V	V	A
		*****	*****	*****	A	A	V	A	A	V	V	V	V	V	V	V	V	A
5 020	CONT9	*MCW STAT7	0298	*	A	A	V	A	A	V	V	V	V	V	V	V	V	A
5 030		*MCW STAT7A	0313	*	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		*****	*****	*****	A	A	V	A	A	V	V	V	V	V	V	V	V	A
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			1	2	3	4	5	6	7	8	9	10	11	12	13	


```

                                CNTJ 1-----v
6 180 CNTJ  *****
6 190          *MCW ZERDCT COB9
          *MCW CONT PAGECT
          *****

                                NEWPG2 1-----
6 200 NEWPG2 *****
7 010          *CC 1*
7 020          *MCW ZERDCT LINECT
7 030          *MCW REPHD1 0234
7 040          *MCW REPHD2 0261
7 050          *MCW REPHD3 0267
7 060          *MCW DATE 0265
7 070          *MCW PAGHDG 0313
7 080          *CS PAGECT 0315
7 090          *CC S*
7 100          *W
7 110          *CS C332
7 120          *CS
7 130          *MCW REPHD4 0240
7 140          *MCW REPHD6 0275
7 150          *CC S*
7 160          *W
7 170          *CS 0299
7 180          *MCW REPHD9 029C
7 190          *MCW
7 200          *CC T*
8 010          *W
8 020          *CS C299
          *****

                                CONTK 1-----
8 030 CONTK *****
          *C FLAGCT PRNTCT
          *****

                                CNTN 1-----
8 040          *B CNTN S-----
          *****

                                CNTQ 1-----
8 050 CNTQ *****
          *MA ACON50 COB9
          *****

                                CNT16 1-----
8 060          *B CNT16 40CC -044 1-----
          *****

                                CNTQ 1-----
8 070          *B CNTQ ACTIND 1-----
          *****

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
8 080          *B CNTL
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

                                CNT16 1-----
8 090 CNT16          *B CNTL ACTIND 1-----
          *****

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
8 100          *B CNTQ
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

```


[illegible]




```

          CCNTP  |-----v
14 040  CCNTP  *C  XFLGCT  PRNTCT  1 2 3 4
          *-----*
          |
          |
          |
14 050  *B  CONTN  S-----
          *-----*
          |
          |
          |
14 060  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
          *B  CONTQ  S-----
          XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

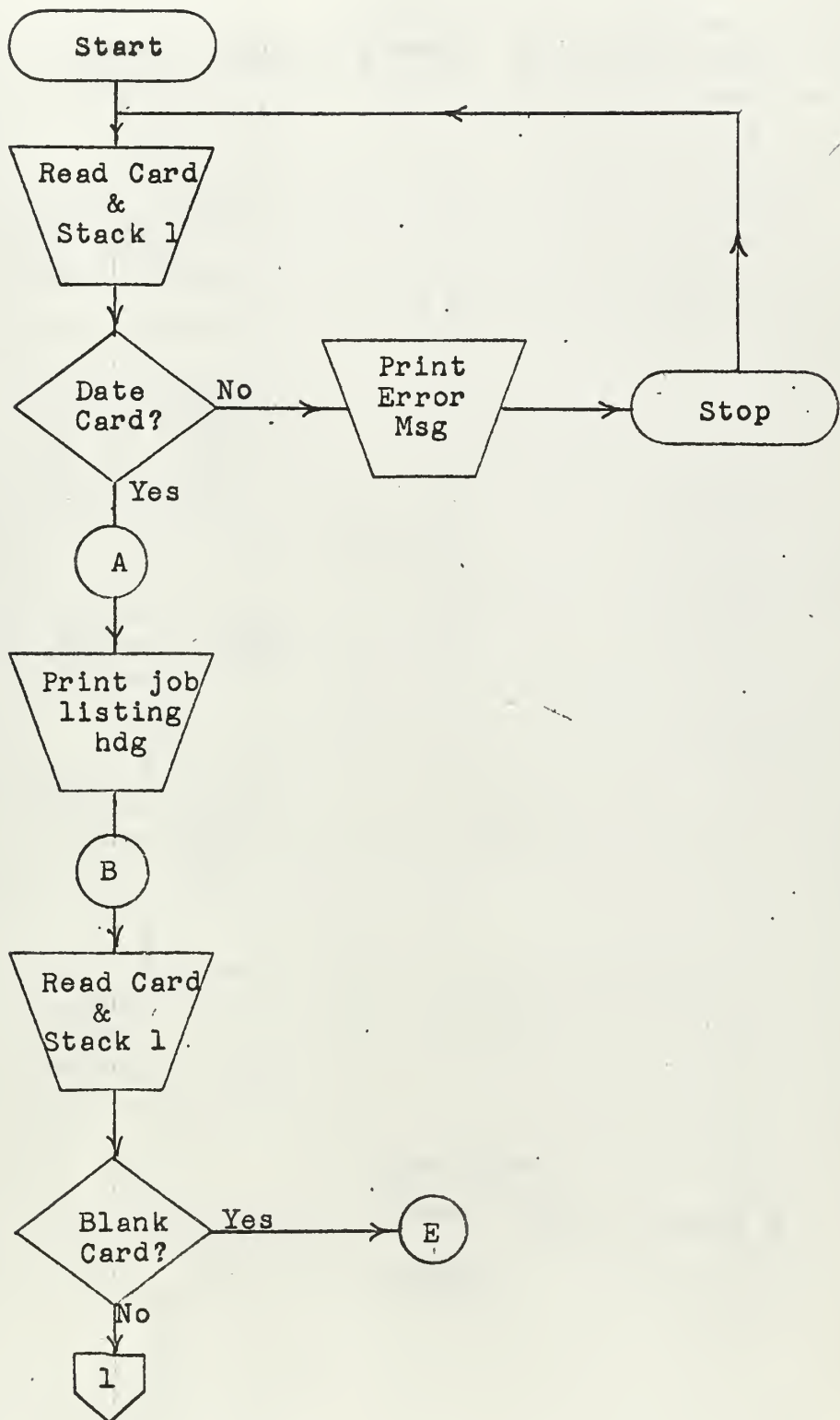
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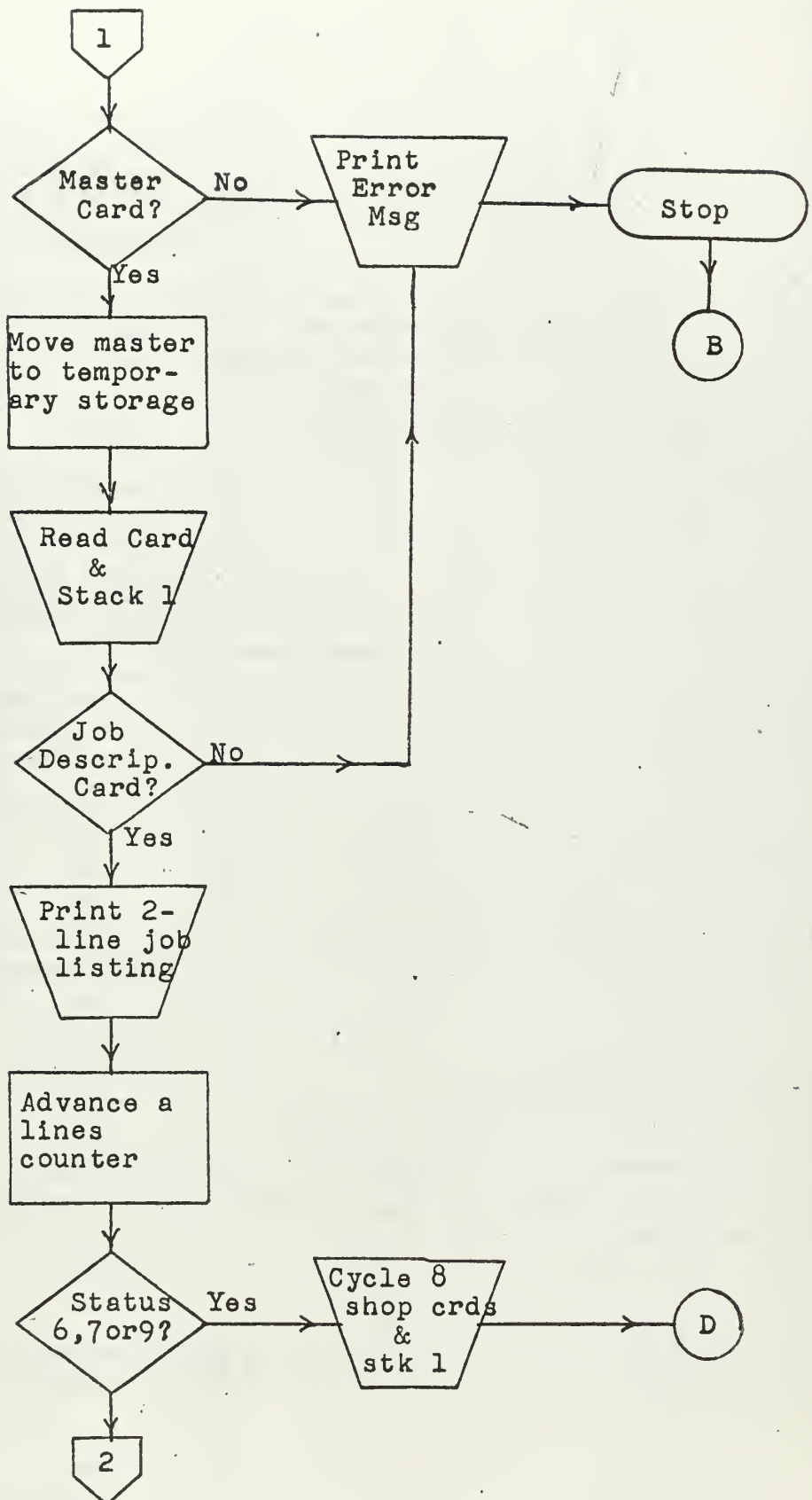
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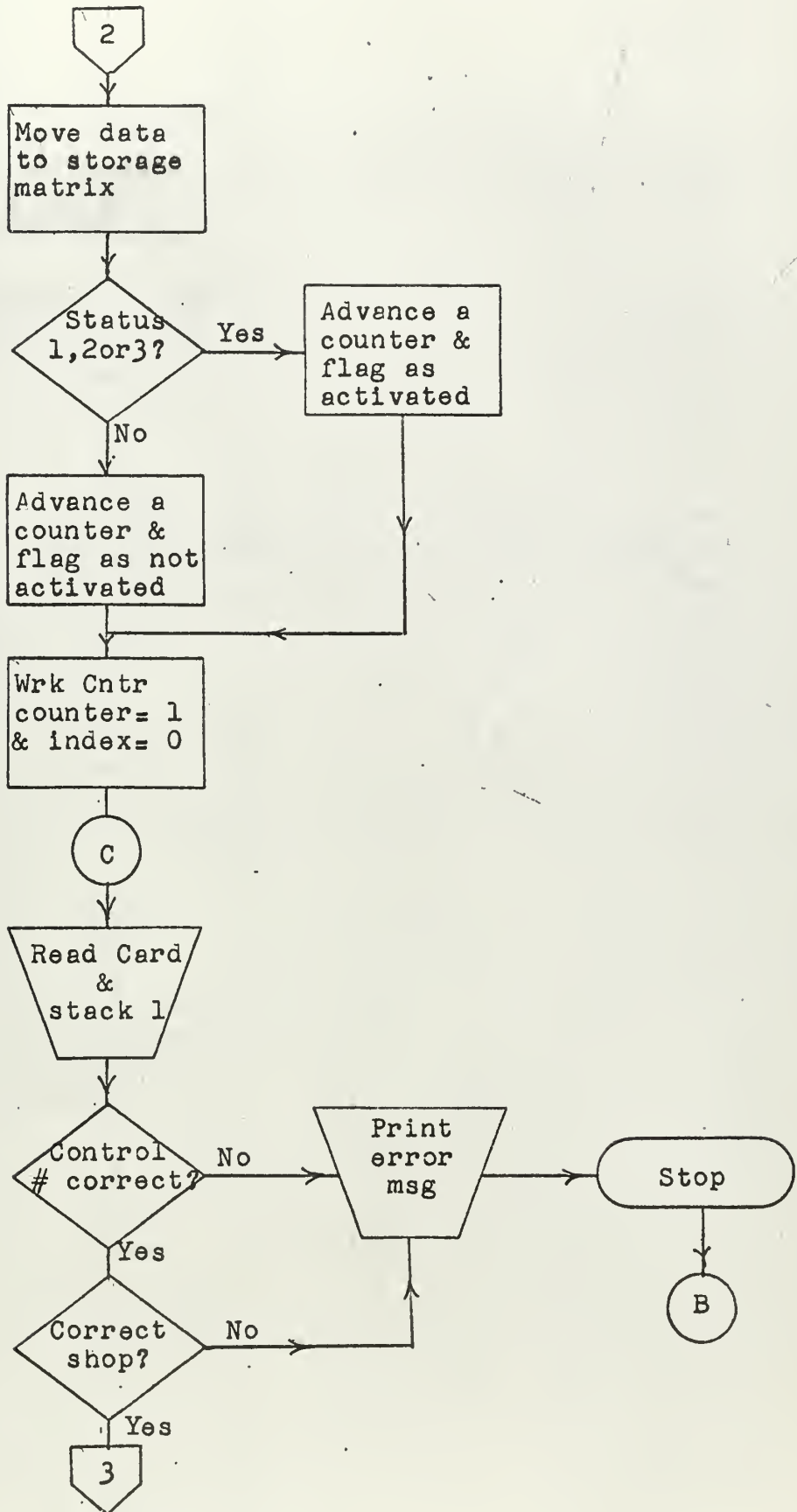
15 010  CCN1    DCW *      001
15 020  PAGECT  DCW 0351   00
15 030  FLAGCT  DCW 0356   000
15 040  XFLGCT  DCW 0361   000
15 050  DATE    DS  0349
15 060  CONFDG  DCW *      JOB LISTING--CONTRCL NO. AS OF
15 070  PAGHDG  DCW *      PAGE NO.
15 080  COLHD1  DCW *      ORIG. NO.  DATE PRIOR.  FUND
15 090  COLHD2  DCW *      JON  RELATED CNTL NOS.
15 100  COLHD3  DCW *      STATUS
15 110  ZERCCT  DCW *      000
15 120  LINECT  DCW 0365   00
15 130  DASH    DCW *      -
15 140  ITPHDG  DCW *      FACILITY=      JCB=
15 150  CON5     DCW *      5
15 180  STAT1   DCW *      SCHEDULED JCB CURRENT WEEK
15 190  STAT2   DCW *      PREVIOUSLY SCHEDULED BUT DEFERRE
15 200  STAT2A  DCW *      D FOR MORE URGENT WORK
16 010  STAT3   DCW *      ACTIVATED AWAITING SCHEDULING
16 011  STAT4   DCW *      ACTIVATED, AWAITING MATERIAL
16 020  STAT5   DCW *      IN APPROVED BACKLOG AWAITING ACT
16 030  STAT5A  DCW *      IVATION
16 040  STAT6   DCW *      PENDING APPROVAL OF HIGHER AUTHO
16 050  STAT6A  DCW *      RITY
16 060  STAT7   DCW *      REIMBURSABLE WORK PENDING APPROV
16 070  STAT7A  DCW *      AL OF REQUESTOR
16 080  STAT8   DCW *      DEFERRED PENDING JOB AMENDMENT
16 090  STAT9   DCW *      DEFERRED BY MAINTENANCE OFFICER
16 100  CON70   DCW *      70
16 101  CON78   DCW *      78
16 120  ACON50  DSA *      0050
16 130  ACCN10  DSA *      C010
16 131  ACCN9   DSA *      CC09
16 140  WCCT    DCW 0368   0
16 150  CON3     DCW *      3
16 160  ACCN5   DSA *      C005
16 170  ASTER   DCW *      *
16 171  DASHES  DCW *      --
16 172  EMPTY   DCW *      0000
16 180  ACTIND  DCW 0371   1

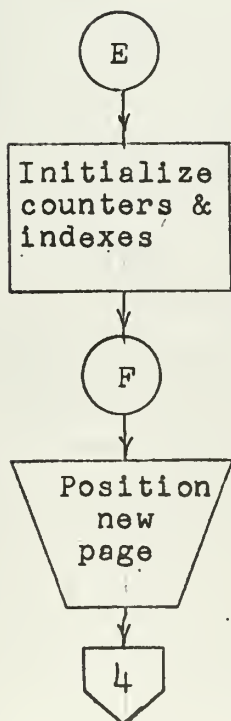
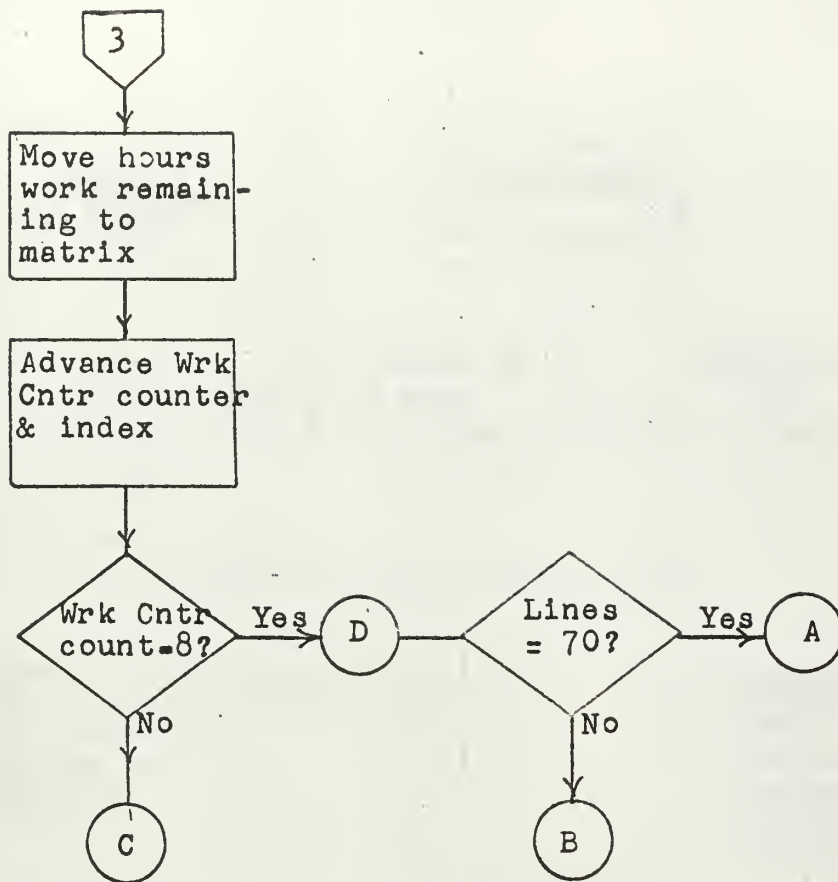
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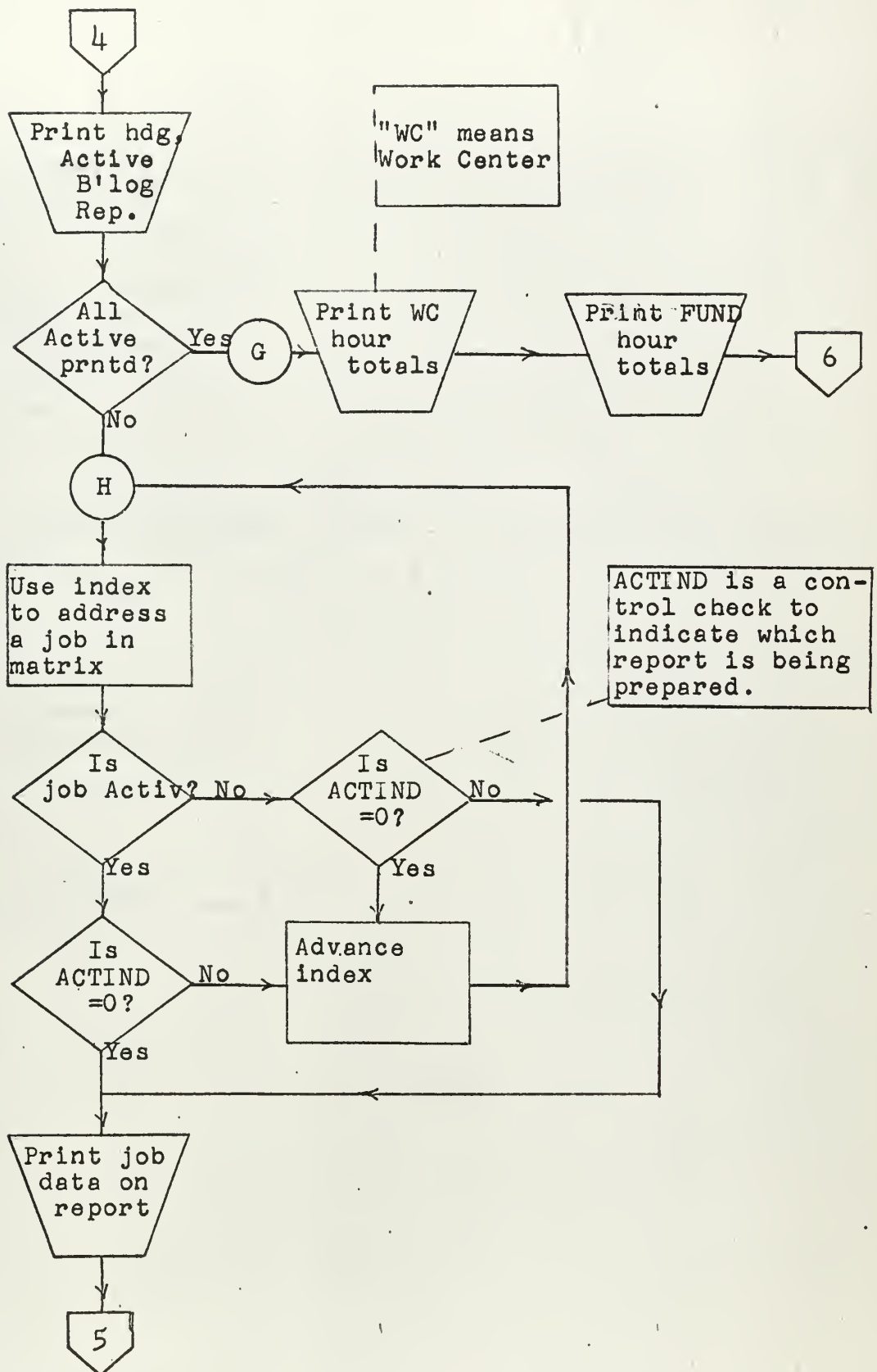

16 190	PRNTCT	DCW 0377	OCO				
16 200	REPHD1	DCW *	JOB LISTING-WORK BACKLOG				
17 010	REPHD2	DCW *	(ACTIVATED, NCT CCMPLETED)				
17 020	REPHD0	DCW *	(NOT ACTIVATED)				
17 030	REPHD3	DCW *	AS CF				
17 040	REPHD4	DCW *	UNITS = MANFCURS				
17 050	REPHD5	DCW *	* = MATERIAL ORDER REQUIRED				
17 060	REPHD6	DCW *	* = HELD FOR MATERIAL				
17 070	REPHD7	DCW *	JCB FUND SCURCE	SHOP 1	SHC		
17 080	REPHD8	DCW *	P 2	SHOP 3	SHOP 4	SHOP 5	
17 090	REPHD9	DCW *	SHOP 6	SHOP 7	SHOP 8		
17 100	ACCN55	DSA *	0550				
17 110	FNDCCD	DCW 0379	0				
17 120	FNDACD	DSA *	0000				
17 130	ACCN48	DSA *	0480				
17 140	REPFT1	DCW *	MANFCUR TOTALS =				
17 150	REPFT2	DCW *	FUND SOURCES	1	2		
17 160	REPFT3	DCW *	3	4	5	6	
17 170	REPFT4	DCW *	7	8			
17 180	JOBEND	DCW *	JOB CCMPLETED				
17 190	ERCRD1	DCW *	STOP DUE TO INCORRECT				
17 200	ERCRD2	DCW *	DATE CARD				
18 010	ERCRD3	DCW *	MASTER JOB CARD				
18 020	ERCRD4	DCW *	JOB CARD FOR SHOP				
18 030	ERCRD5	DCW *	JCB DESCRIPT. CARD				
18 040		*END	START				*

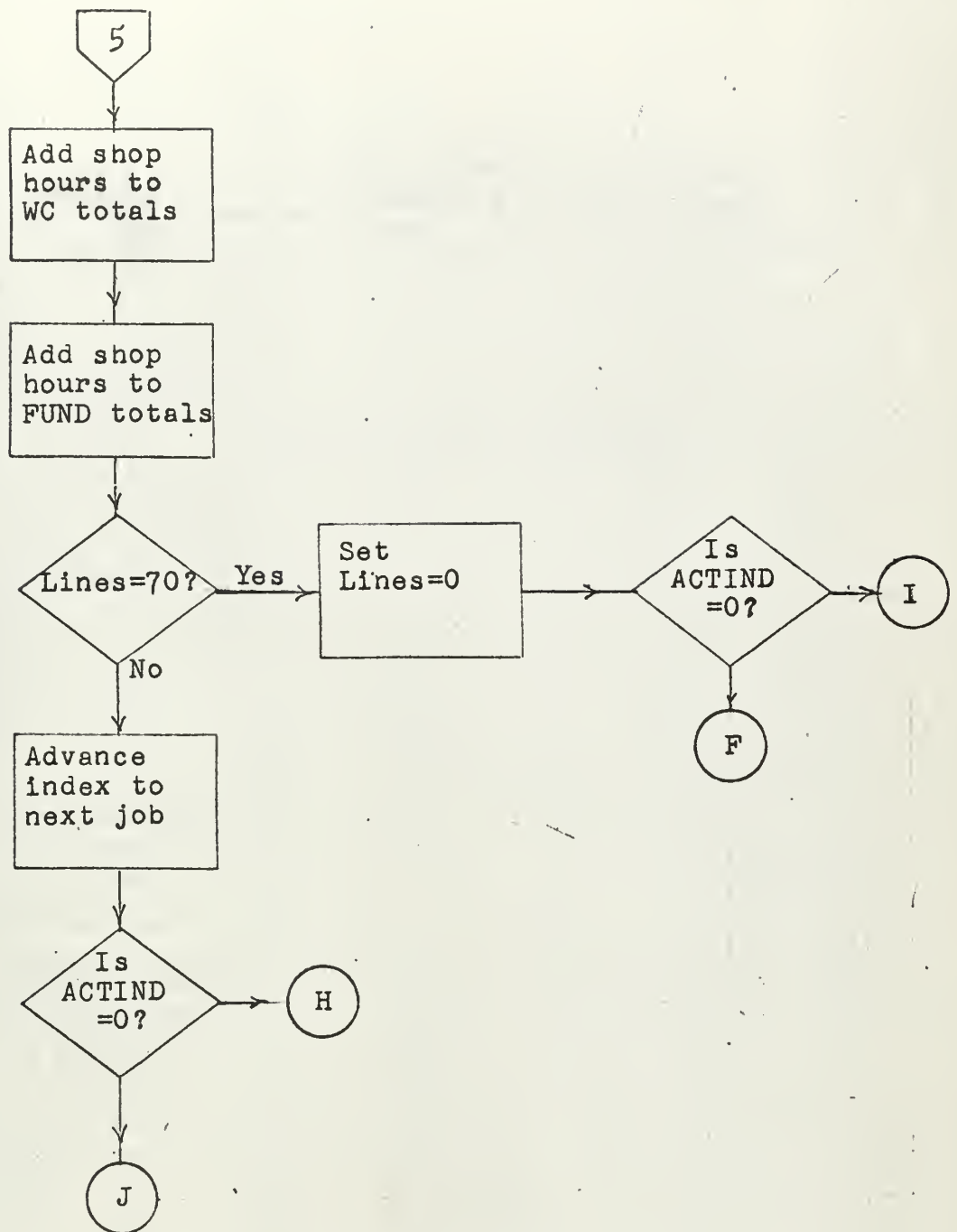


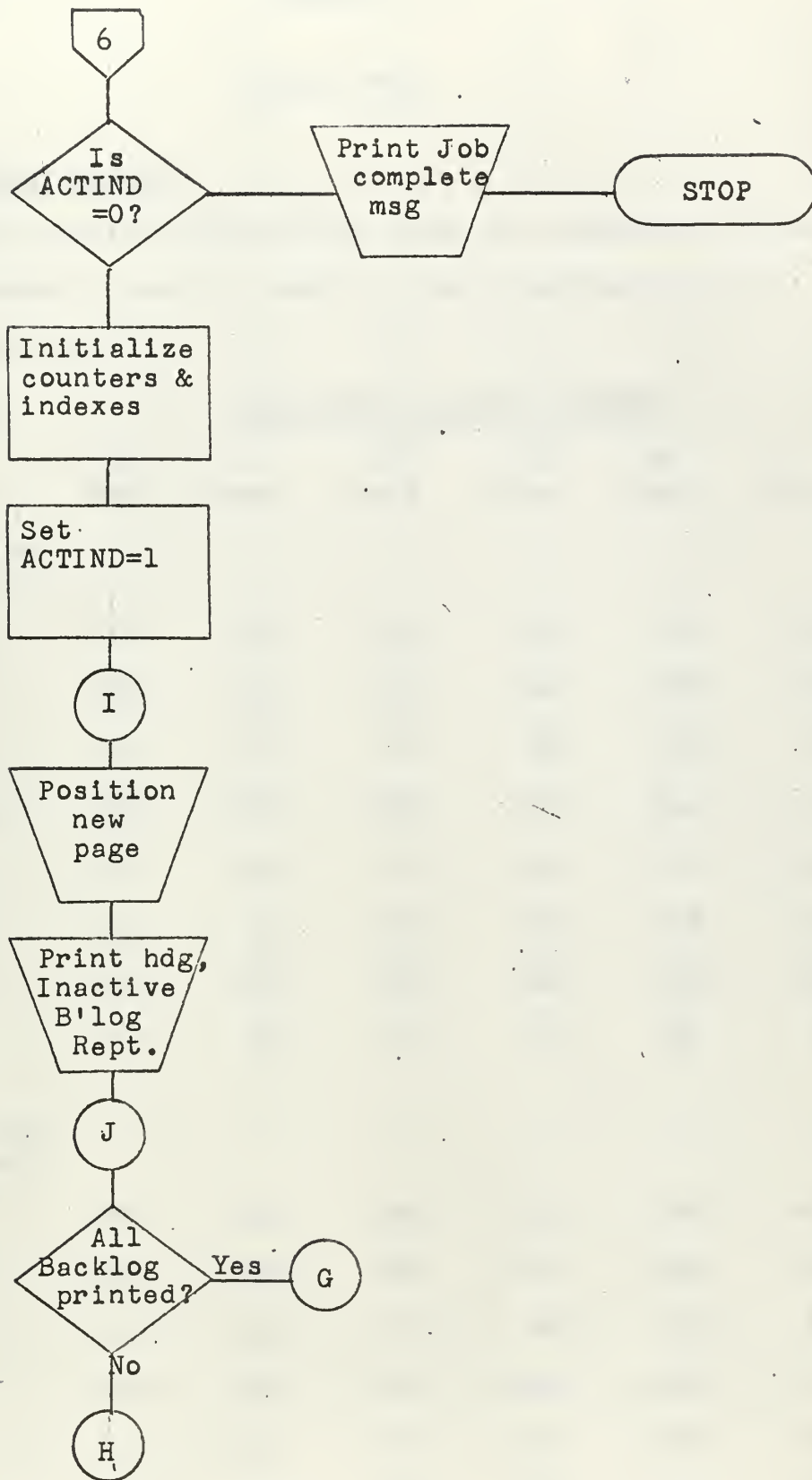












APPENDIX C

SYSTEM TEST

I. Parameter values.

The following tabulation shows the parameter values used for each of the six weeks in the simulated test of the Autosked system.

<u>Parameter</u>	<u>Value for the Week Ending:</u>					
	25 May	4 June	11 June	18 June	25 June	2 July
Minimum Manhours for Fund Source						
#1	160	130	160	160	180	180
#2	630	480	630	700	680	730
#3	47	37	47	30	30	40
#4	280	230	280	300	300	300
#5	570	450	570	600	600	650
#6	120	95	120	140	140	140
#7	340	270	340	300	280	280
#8	72	57	72	75	80	75
Maximum Manhours for Fund Source						
#1	240	210	240	240	220	220
#2	930	780	930	1100	880	830
#3	67	57	67	60	50	60
#4	420	370	420	450	500	400
#5	870	750	870	900	1000	800
#6	180	155	180	200	200	200

<u>Parameter</u>	<u>Value for the Week Ending:</u>					
	25 May	4 June	11 June	18 June	25 June	2 July
#7	500	430	500	450	420	400
#8	108	93	108	115	110	120
Manhours for Work Center						
#1	390	312	390	390	390	390
#2	190	152	190	190	190	190
#3	470	376	470	470	470	470
#4	300	240	300	300	300	300
#5	140	112	140	140	140	140
#6	170	136	170	170	170	170
#7	280	224	280	280	280	280
#8	810	650	810	810	810	810
Season Codes	1-2-3	1-2-3	1-2-3	1-2-7	1-2-7	1-2-7
Scheduleable	-4-6	-4-6	-4-6			
Payoff Constants						
A	100	100	100	100	100	100
B	50	50	50	50	50	50
C	40	40	40	40	40	40
D	35	35	35	35	35	35
Workdays	5	4	5	5	5	5

II. Sample printed outputs.

The following pages are samples of the printed outputs generated during the system test. Only two pages of the Job Listing are presented.

ORIG. NO.	DATE	PRIOR.	FUND	JCN	RELATED CNTL NOS.	STATUS
228 FACILITY=MCASG JOB= CLEAN ALL CATCH BASINS AND DO DRAINAGE WORK.						
26	359-64	4170	5	7	00000 00229 00000	IN APPROVED BACKLOG AWAITING ACTIVATION
288 FACILITY=02014 JOB= INSTALL WIRE MESH ON 3 CELL BLOCKS						
49	17-65	4192	9	3	44006 00000 00000	ACTIVATED AWAITING SCHEDULING
740 FACILITY=2910C JOB= REPAINT LOWER FLOOR ROOMS.						
35	11-65	4200	4	5	00000 00000 00000	IN APPROVED BACKLOG AWAITING ACTIVATION
983 FACILITY=MCASG JOB= REMOVE WELDS FROM HELD LANDINGS AND RUNDY OVERRUNS. TERILIZE AREA.						
26	358-64	4155	5	7	40510 00000 00000	ACTIVATED AWAITING SCHEDULING
1007 FACILITY=ROADS JOB= REPAIR ASPHALT ROADS.						
10	44-65	4204	5	2	00000 00000 00000	IN APPROVED BACKLOG AWAITING ACTIVATION
1301 FACILITY= 3252 JOB= MOVE PAINT SPRAY BOOTH						
12	116-11	5111	9	1		DEFERRED BY MAINTENANCE OFFICER
1338 FACILITY=ORLPR JOB= CONSOLIDATED MINOR WORK TO REAL PROPERTY.						
16	125-65	5104	4	2	45022 00000 00000	ACTIVATED AWAITING SCHEDULING
1670 FACILITY=MISCL JOB= REPLACE ELECTRIC PANELS IN 27 Q-HUTS.						
12	9-65	4210	6	2	00000 00000 00000	IN APPROVED BACKLOG AWAITING ACTIVATION
1877 FACILITY=ROADS JOB= REPAIRS TO ROADS AND SIDEWALKS.						
09	34-65	4257	5	2	00000 00000 00000	IN APPROVED BACKLOG AWAITING ACTIVATION
2443 FACILITY=02045 JOB= MISCELLANEOUS REPAIRS AND EXTERIOR PAINT.						
11	97-64	4240	6	2	00000 00000 00000	IN APPROVED BACKLOG AWAITING ACTIVATION
2584 FACILITY= 2112 JOB= INSTALL VENTILATION SYSTEM						
16	834-70	5111	5	6		REIMBURSABLE WORK PENDING APPROVAL OF REQUESTOR
2892 FACILITY= HGRS JOB= INSTALL GROUNDING SYSTEM						
12	497-38	5111	3	7	45891	ACTIVATED AWAITING SCHEDULING

ORIG. NO.	DATE	PRIOP.	FUND	JCN	RELATED CNTRL NOS.	STATUS
2912	FACILITY=00109	JOB= CLOSED QUARTERS.				
05	149-65	4284	4	5	45112 00000 00000	SCHEDULED JOB CURRENT WEEK
3260	FACILITY=WATER	JOB= REPAIRS TO WATER MAIN VENT PITS				
11	827-40	5111	5	2		IN APPROVED BACKLOG AWAITING ACTIVATION
3308	FACILITY= USNH	JOB= INSTALL EXHAUST FANS				
17	508-12	5111	4	7	40511	ACTIVATED AWAITING SCHEDULING
3314	FACILITY=2000+	JOB= TERNITE TREATMENT OF 26 BUILDINGS				
12	18-65	4210	5	5	00300 00000 00000	IN APPROVED BACKLOG AWAITING ACTIVATION
3315	FACILITY=2000+	JOB= TERNITE TREATMENT OF 27 BUILDINGS				
12	19-65	4210	5	5	45118 00000 00000	SCHEDULED JOB CURRENT WEEK
3410	FACILITY=GRNLS	JOB= FIRM AND POUR 320 CONCRETE STEPPING STONES				
20	16-65	4210	6	5	42120 00000 00000	SCHEDULED JOB CURRENT WEEK
3522	FACILITY=00027	JOB= REPLACE TILE DECK AND WALLS IN SHOWER				
09	144-64	4180	5	2	45104 00000 00000	SCHEDULED JOB CURRENT WEEK
3574	FACILITY=27208	JOB= CLOSED QUARTERS				
05	149-65	4270	4	2	45111 00000 00000	ACTIVATED AWAITING SCHEDULING
3562	FACILITY=24165	JOB= INTERIOR PAINTING				
11	45-65	4290	6	2	00000 00000 00000	IN APPROVED BACKLOG AWAITING ACTIVATION
3877	FACILITY=LAWNS	JOB= TRIM SHRUBBERY				
17	15-65	5111	7	4		IN APPROVED BACKLOG AWAITING ACTIVATION
3934	FACILITY=HBRDP	JOB= PM 100 QUARTERS REEFERS.				
17	10-65	5080	5	5	40712 00000 00000	ACTIVATED AWAITING SCHEDULING
3935	FACILITY=HBRDP	JOB= PM 90 QUARTERS REEFERS.				
17	11-65	5080	6	4	40812 00000 00000	ACTIVATED AWAITING SCHEDULING

JOB LISTING-WORK BACKLOG (NOT ACTIVATED) AS OF 25 MAY 1965

JOB	FJND	SOURCE	UNITS = MANHOURS								SHOP 8
			SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7		
228	7		--	--	--	--	--	--	12	301	
740	5		--	--	40	--	--	--	--	--	
1007	2		--	--	--	--	--	--	--	853	
1670	2	8	--	--	--	326*	--	--	--	--	
1877	2	--	--	--	--	--	--	--	--	500	
2443	2	29	4	100	7	--	--	--	--	--	
3260	2	--	33	--	--	--	24	32	40	957*	
3314	5	--	--	--	--	--	--	--	--	--	
3862	2	--	--	417	--	--	--	--	--	300	
3877	4	--	--	--	--	--	--	--	--	--	
4468	7	86	--	568	--	--	--	--	--	332	
4911	2	--	--	--	--	--	--	16	32	--	
5004	6	280	--	40	--	--	--	--	--	--	
5686	4	16	272	108	16	--	16	--	--	8	
5739	6	--	--	58	--	--	--	42	--	--	
5932	2	--	--	--	--	79	--	16	--	--	
6591	5	300	--	--	--	--	--	840	600	--	
7002	4	223	--	--	--	--	--	--	--	206	
8045	6	--	--	--	--	--	--	--	--	--	
9176	2	--	--	--	181*	--	--	--	--	--	

JOB LISTING-WORK BACKLOG (NOT ACTIVATED) AS OF 25 MAY 1965

PAGE NO. 2

JOB	FUNO	SOURCE	UNITS = MANHOURS									SHOP 9
			SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8		
8303	8		240	--	--	--	--	--	24	--	--	
8390	6		--	--	--	--	64	--	32	--	--	
8518	2		--	--	--	--	--	210*	--	--	--	
8558	5		--	24	8	8	--	145*	8	--	--	
8575	5		--	24	8	8	--	145*	8	--	--	
8793	2		--	145	30	--	--	--	--	60	--	
8798	2		24	16	8	16	16	32	16	--	--	
8817	2		--	--	--	--	--	98	42	--	--	
8890	2		87	3	43	36	--	48	11	32	--	
9055	3		4	--	--	16	--	--	16*	--	--	
9315	6		--	24	270*	--	--	--	--	--	--	
9664	1		--	--	--	--	--	--	328	--	--	
9685	8		--	--	--	--	--	--	--	352	--	
9709	2		51	--	20	--	--	--	24	--	--	
9858	1		--	--	--	--	--	160	64	48	--	
9897	1		200	--	--	--	--	--	16	--	--	
10088	5		--	--	120	--	--	--	--	--	--	
10330	5		72	24	5	74	--	48	10	36	--	
10331	5		286	128	136	2	--	--	60	188	--	
10770	2		--	--	--	--	--	--	--	198	--	

JOB LISTING-WORK BACKLOG (NOT ACTIVATED) AS OF 25 MAY 1965									
UNITS = MANHOURS * = MATERIAL ORDER REQUIRED									
JOB	FUND SOURCE	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8
10882	2	--	--	--	--	--	--	--	128
MANHOUR TOTALS =		1906	697	1379	690	159	926	1649	5039
FUND SOURCES		1	2	3	4	5	6	7	8
MANHOUR TOTALS =		816	4391	36	951	4212	1056	967	616

JOB LISTING-WORK BACKLOG (ACTIVATED, NOT COMPLETED) AS OF 25 MAY 1965

PAGE NO. 1

JOB	FUND	SOURCE	UNITS = MANHOURS								* = HELD FOR MATERIAL
			SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8	
288		3	--	--	--	--	--	--	106*	--	
983		7	--	--	--	--	--	--	--	960*	
1338		2	58	--	26	24	--	19	8	--	
2892		7	--	--	--	24*	--	--	32*	270*	
2912		5	76	105	118	4	--	--	13	47	
3308		7	48	--	8	40	--	--	--	--	
3315		5	--	--	--	--	--	--	--	474	
3410		5	--	--	--	--	--	--	--	200	
3522		2	--	500	--	--	--	48	24	120	
3574		2	2	--	44	--	--	--	--	--	
3934		5	--	--	--	--	167	--	--	--	
3935		4	--	--	--	--	144	--	--	--	
3967		6	--	--	--	56	--	--	--	40	
4465		4	102	20	560	--	--	--	--	--	
4766		1	--	--	--	--	519	16	8	--	
4824		2	542*	--	--	64	--	--	64	280	
4926		7	--	--	--	288*	--	--	16*	--	
4961		4	--	--	--	--	--	--	155*	--	
5374		8	32	--	3	32	64	--	--	--	
5887		2	--	--	--	--	32	--	--	--	

JOB LISTING-WORK BACKLOG (ACTIVATED, NOT COMPLETED) AS OF 25 MAY 1965

PAGE NO. 2

		UNITS = MANHOURS											
		* = HELD FOR MATERIAL											
JOB	FUND SOURCE	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8				
6247	2	51	16	22	6	--	36	44	--				
6705	3	24	--	6	--	--	--	--	16				
6934	7	40	48	1199*	48	--	72	--	--				
7073	2	200*	--	--	16	30	--	32	16				
7751	3	71	--	18	53	4	--	--	16				
8073	5	--	--	--	--	--	--	--	256				
8177	2	12	--	--	--	--	4	2	--				
8330	2	2	--	164	--	--	--	--	--				
8494	2	95	--	68	--	--	--	--	--				
8560	5	--	24	28	18	--	145*	18	--				
8772	7	32	--	--	2*	--	--	56	--				
8999	3	74	8	32	54	--	51	6	--				
9489	2	44	--	162	--	--	--	33	--				
9611	2	8	--	31	--	--	4	2	38				
9703	1	--	--	--	54	--	64	16	--				
9742	1	9	24	--	20	80	--	--	--				
9945	4	8	40	--	--	--	32	--	40				
10089	5	--	--	--	--	--	--	--	160				
10547	8	56	4	8	48	9	--	24	--				
10582	2	--	--	--	--	160	16	16	--				

JOB LISTING-WORK BACKLOG (ACTIVATED, NOT COMPLETED) AS OF 25 MAY 1965

UNITS = MANHOURS * = HELD FOR MATERIAL

JOB	FUND SOURCE	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8
10754	6	--	--	--	--	--	200	--	--
10767	2	24	--	6	--	--	--	--	--
10821	5	32	--	90	--	--	--	--	--
10823	2	131	8	24	34	18	10	--	--
10884	4	--	--	--	1335	--	--	--	--
11085	5	--	--	--	--	--	--	170	--
11667	1	--	--	--	--	--	--	160*	--
MANHOUR TOTALS =		1773	795	2717	2220	1227	717	1005	2933
FUND SOURCES		1	2	3	4	5	6	7	8
MANHOUR TOTALS =		969	3442	539	2536	2143	296	3183	279

TENTATIVE SHOP WORK SCHEDULE FOR THE WEEK ENDING 14 JUNE 1965

		UNITS = MANHOURS									
JOB	FUND	PAYOFF	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8	
10821	5	831	FIN	--	90	--	--	--	--	--	
10823	2	767	87	FIN	24	FIN	FIN	8	--	--	
10884	4	701	--	--	--	92	--	--	--	--	
11085	5	338	--	--	--	--	--	--	45	--	
11667	1	701	--	--	--	--	--	--	64	--	
MANHOUR TOTALS =			312	60*	376	240	112	136	183*	650	
FUND SOURCES			1	2	3	4	5	6	7	8	
MANHOUR TOTALS =			205	482	57	254	543	80*	416	32*	

* = INSUFFICIENT ACTIVATED WORK TO MEET SPECIFIED REQUIREMENTS

TENTATIVE SHOP WORK SCHEDULE FOR THE WEEK ENDING 4 JUNE 1965

PAGE NO. 1

UNITS = MANHOURS

JOB	FJND	PAYOFF	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8
288	3	280	--	--	--	--	--	--	18	--
983	7	370	--	--	--	--	--	--	--	146
2912	5	752	76	20		FIN	--	--	FIN	47
3315	5	705	--	--	--	--	--	--	--	152
3410	5	675	--	--	--	--	--	--	--	40
4465	4	668	FIN	FIN	49	--	--	--	--	--
4766	1	772	--	--	--	--	112	16	FIN	--
4824	2	752	27	--	--	16	--	--	--	192
4926	7	840	--	--	--	132	--	--	FIN	--
4961	4	647	--	--	--	--	--	--	41	--
5374	8	420	32	--	--	--	--	--	--	--
6247	2	755	51	FIN	22	FIN	--	--	FIN	--
6634	7	701		FIN	138	FIN	--	--	--	--
8073	5	754	--	--	--	--	--	--	--	73
8999	3	638	39	FIN			--	--	FIN	--
9489	2	674	FIN	--	53	--	--	--	FIN	--
9611	2	341		--		--	--	--	2	--
9703	1	752	--	--	--		--		13	--
9945	4	836	FIN	40	--	--	--	32	--	FIN
10754	6	834	--	--	--	--	--	80	--	--

SHOP WORK SCHEDULE FOR THE WEEK ENDING 4 JUNE 1965

UNITS = MANHOURS

JOB	FUND	PAYOFF	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8
253	3	280	--	--	--	--	--	--	16	--
983	7	370	--	--	--	--	--	--	--	160
2912	5	752	76	20		FIN	--	--	FIN	47
3315	5	705	--	--	--	--	--	--	--	148
3410	5	675	--	--	--	--	--	--	--	41
4465	4	669	FIN	FIN	65	--	--	--	--	--
4766	1	772	--	--	--	--	112	16	FIN	--
4824	2	752	--	--	--	--	--	--	--	160
4926	7	840	--	--	--	147	--	--	FIN	--
4961	4	647	--	--	--	--	--	--	42	--
5374	8	420	20	--	--	--	--	--	--	--
6247	2	755	51	FIN	22	FIN	--	5	FIN	--
6834	7	701	22	FIN	101	FIN	--	--	--	--
7751	3	368	--	--	--	--	--	--	--	4
8073	5	754	--	--	--	--	--	--	--	66
8177	2	702	12	--	--	--	--	--	2	--
8999	5	638	35	FIN	2		--	--	FIN	--
9489	2	674	FIN	--	72	--	--	--	FIN	--
9611	2	341	--	--	--	--	--	--	2	24
9945	4	836	FIN	40	--	--	--	32	--	FIN

SHOP WORK SCHEDULE FOR THE WEEK ENDING 4 JUNE 1965

UNITS = MANHOURS

JOB	FUND	PAYOFF	SHOP 1	SHOP 2	SHOP 3	SHOP 4	SHOP 5	SHOP 6	SHOP 7	SHOP 8
10754	6	834	--	--	--	--	--	73	--	--
10821	5	831	FIN	--	90	--	--	--	--	--
10823	2	767	96	FIN	24	FIN	FIN	10	--	--
10884	4	701	--	--	--	93	--	--	--	--
11085	5	338	--	--	--	--	--	--	45	--
11667	1	701	--	--	--	--	--	--	64	--

MANHOUR TOTALS = 312 60* 376 240 112 136 171* 650

FUND SOURCES	1	2	3	4	5	6	7	8
MANHOUR TOTALS =	192	480	57	272	533	73*	430	20*

* = INSUFFICIENT ACTIVATED WORK TO MEET SPECIFIED REQUIREMENTS

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